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This monograph contains the following essays including one written in German: (1) "Views on the Implementation of the Curriculum--Experiences of the Finnish Practice" (Pertti Kansanen); (2) "Modalization Processes in Student Biographies" (Rainer Kokemohr); (3) "Problemhafter Unterricht im Fach Physik mit dem Ziel des Auslosens schopferischen Lernens" (Hansjoachim Lechner); (4) "Universities after 1945. The Age of Global Power or Crisis" (Andrzej Radziewicz-Winnicki); and (5) "Reform Intentions and Their Implementation" (Erik Wallin). (JD)

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RESEARCH REPORT 54

Department of Teacher Education
University of Helsinki

DISCUSSIONS ON SOME EDUCATIONAL ISSUES II

Edited by Pertti Kansanen

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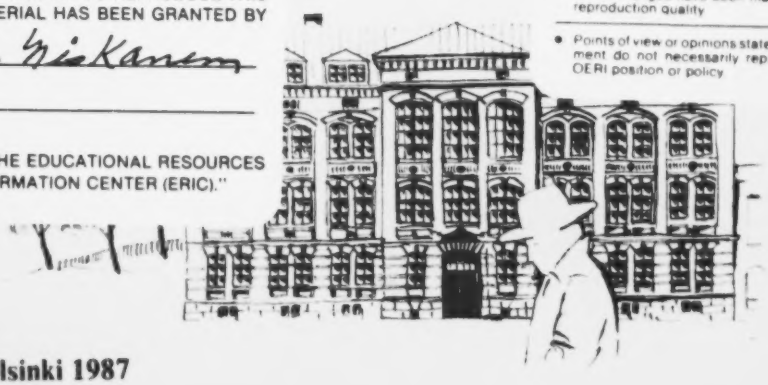

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Contents

Contributors 3

Views on the Implementation of the Curriculum - Experiences of the Finnish Practice by Pertti Kansanen 5

Modalization Processes in Student Biographies by Rainer Kokemohr 19

Problemhafter Unterricht im Fach Physik mit dem Ziel des Auslösens schöpferischen Lernens by Hansjoachim Lechner 29

Universities after 1945. The Age of Global Power or Crisis by Andrzej Radziewicz-Winnicki 55

Reform Intentions and Their Implementation by Erik Wallin 71

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VIEWS ON THE IMPLEMENTATION OF THE CURRICULUM - EXPERIENCES OF THE FINNISH PRACTICE [1]

Pertti Kansanen

1. Introduction

The implementation of the new curriculum (monsterplan) in Norway involves a large number of problems almost identical with those encountered in the corresponding process in Finland. The development of the school system after the Second World War has been in the main quite similar in all Nordic countries, in particular in Sweden, Norway and Finland. The "monsterplan" was published in 1974, and the new curriculum for the Finnish comprehensive school was completed in 1970 and came into force gradually from north to south in such a way that the comprehensive school system was operating in the whole country by 1977. Immediately upon being made public the curriculum and its implementation became subject to lively research. Below I will endeavour to analyze the research results obtained regarding the curriculum for the Finnish comprehensive school and simultaneously to compare them with the situation in Norway.

It can be said that in Finland the development of the school system towards the comprehensive school occurred under a largely similar atmosphere of discussion as in Norway (cf. Telhaug & Seidenfaden 1981). When the comprehensive school was finally achieved in Finland, the question was no longer merely of an adminstrative reform of the school system but also of a strive for didactic reform. Thus a considerably larger number of objectives and purposes were stated in the curriculum than had been previous practice, and so the two-part curriculum was divided into a part laying out the principles and a part consisting of subject-specific plans.

[1] The first version of this paper was presented at the Fourth Scandinavian-German Workshop on Curriculum Research and Development 1983 in Norway.

The objectives of teaching were presented in the Finnish curriculum in a separate chapter, and they were immediately subjected to research aiming at analyzing the esteem, comprehensibility and feasibility of the objectives presented. This research was mainly based on questionnaires by means of which evaluations of the objectives were obtained primarily from teachers, persons studying to be teachers, and representatives of school administration. Subsequently the discussion regarding the objectives expanded into a large-scale research project aiming, through a nationally representative sampling, to analyze the opinions of teachers, pupils and parents regarding the possible objectives of school education (Kari et al. 1978).

The curriculum for the Finnish comprehensive school has been written in a spirit which leaves the implementation to the teacher's discretion. The extensive part dealing with the objectives does not include actual normative directives for practical teaching. It was thought that each teacher would consider the implementation of the objectives on the basis of his own professional competence. Nevertheless, the first part of the curriculum contains a great deal of didactic text regarding topics such as methods of teaching, teaching aids, teaching materials, questions of differentiation, and evaluation of the results of school work. The instructions included in the didactic text are in so general a form that on the basis of the instructions it cannot be determined unambiguously what the teaching should be like in practice. More precisely, this means that the curriculum does not include a direct description of the teaching process.

Summarizing, it can be said that the national curriculum of 1970 does not contain clues to concrete arrangements, but nevertheless an attempt has been made to undermine, by favouring individual work and group work, the position of traditional classroom teaching. In the following I shall focus on the significance of teaching materials, teacher education and textbooks of didactics in the implementation of the curriculum. These means of directing the curriculum are in part direct, in part indirect, but ultimately there exists no very certain information regarding their effect. Finally, there are many other factors effective in connection with them, and these factors may obscure their independent significance.

2. Teaching materials regulating the curriculum

Research of the curriculum is by nature largely content analysis in which the text of the curriculum is analyzed without direct contact with the empirical teaching process. If the purpose is to clarify the problem of the implementation of the curriculum, it cannot be done without being familiar with actual empirical teaching. However, there exist very few research results describing what teaching is like. There are many reasons for the small number of studies. The problem as such is too extensive and obscure; this is illustrated by some summaries of research results (e.g. Dunkin & Biddle 1974 and Gage 1978). There are too many viewpoints to choose from, and the curriculum and the teaching which implements it must somehow be delineated.

Another reason for the lack of reliable research results regarding what teaching is like in a school class may be that the question seems too simple. We all have our prejudices on the basis of which we think we know what teaching is like. Nevertheless, the experience of nearly every teacher and researcher is limited to rather scanty empirical observation, even though that is usually non-systematic. It is true that at least in part these prejudices are true, for the framework factors (e.g. the size of a class) included in the curriculum dictate the basic solutions.

When the decision was made to reform teaching in Finland in the curriculum of 1970, pupil-oriented work methods were specifically recommended. An appeal was made to the professional skills of the teacher by requiring more versatile use of work methods than before, and systematic variation of such methods. Individual work and group work in particular were put forward in the recommendations. Likewise, ample use of teaching aids (e.g. audiovisual aids) and a flexible and varied application of the teaching materials were recommended in order to increase variation in teaching. The spirit of the curriculum is pupil-oriented and progressive, even though details are not stated in the text. It has been interesting to observe how the curriculum has been received in schools, and we also have some research results regarding it.

The implementation of the curriculum hardly constitutes a great administrative problem, although it, of course, requires supervision. The provisions and regulations are in principle clear: the subjects of study are listed, the numbers of lessons for pupils and teachers are stated, the numbers of pupils and the methods of differentiation are defined, etc., but within the walls of the classroom a rather extensive freedom is retained to organize the teaching the way the teacher and the pupils best deem it. The greater the number of proposals presented for changes in the process or spirit of teaching, the more complicated the problem becomes.

A revision of the curriculum naturally also requires revision of the teaching materials. In addition to updating the contents of teaching, the new materials must comply with the spirit defined in the revised curriculum. In Finland, textbooks are approved by the National Board of Education, but the writers are selected and the supply is regulated by commercial publishers. In the inspection of teaching materials, special attention is paid to the compliance of the materials with the curriculum. This is relatively easy as long as what is in question is the content of teaching, but it is more difficult to control the didactic implementation of the curriculum in the materials. In any case it can be said that a textbook is a kind of operationalization of the curriculum, one of the possible ways of interpreting the curriculum as regards one subject.

From the above there follow two important conclusions and practical consequences. First, when a teacher uses a textbook in teaching, he can be sure that his teaching is in compliance with the curriculum as regards the content of his teaching. Thus it is not necessary for him personally to know the curriculum. Of course, the teaching becomes restricted and is based on teaching materials only. We have empirical proof that teachers have not familiarized themselves with the curriculum or have done so quite one-sidedly (e.g. Kansanen 1981). Learning on the materials involves even other kinds of restricting factors. An analysis of teaching materials shows quickly that they include a great deal of exercises and assignments which lead to joint exercising and teacher-oriented work methods. This strongly standardizes teaching.

Another even more serious consequence of the following of the teaching materials results from the fact that textbooks

present only subject-specific objectives and contents. Nevertheless, the curriculum contains a large number of so-called general objectives which are intended for all teaching and for every teacher. If the teacher personally does not know the curriculum and uses teaching materials slavishly, he cannot have any idea of the general objectives. In this case, for example the affective objectives of teaching enter the teaching through some other channel, of course by mediation of the teacher, but at least not as adopted from the curriculum. In the event that the practice of teaching is not in harmony with the curriculum, it is natural to conclude that this incongruence is due to the fact that the curriculum is not known. On the other hand, it must be admitted that this incongruence may prevail even if the curriculum is known. Researchers have long wondered at the tenacity of the prevalence of so-called frontal teaching (cf. Hoetker & Ahlbrand 1969). Certainly, the framework factors of teaching are strong regulators here, but detachment from frontal teaching does not seem to occur with the aid of teaching materials.

Nowadays there is clear empirical proof of the fact that teachers lean too strictly on teaching materials. This dependance on the materials leads to teacher-centred work methods, but at the same time the materials homogenize teaching among schools, which of course is not a merely negative fact. This phenomenon is not typical of only the Finnish school, for Gustafsson (1980) presents similar results from Sweden.

In a Finnish study Komulainen et al. (1981) obtained the result that nearly 70 percent of teaching is by application of teacher-oriented methods and only about 3 percent by methods of interaction. This result was based on intensive observation of six forms. The result was interpreted as being due to excessive dependence on materials, and the materials themselves were found to lead to teacher-oriented work methods. A decision was made to study this hypothesis in greater detail and to make observations on the ways in which teachers use materials at school. The curriculum for the comprehensive school was analyzed as the background with the purpose of finding in it implicit instructions regarding the work methods favoured in it and the spirit in which the different materials should be used (for more details, see Kansanen & Uusikylä & Kalla 1980; Kansanen & Uusikylä 1982).

For the study an observation form was developed according to which teaching was monitored by recording certain events in five-minute sequences. The study covered 350 lessons of 40 teachers. In addition, observation material for the background description was obtained of 115 lessons by Flanders' IAC method. When the work methods were divided into teacher-oriented ones (presentation by the teacher, questioning by the teacher, joint exercises), pupil-oriented ones (individual work, presentation by pupils, group work), and interactive ones (teaching discussion, party), these were distributed in a proportion of 72 percent to 24 percent to 4 percent. The prevalence of teacher-oriented work methods was in clear association with the teaching material used. Almost two-thirds of a lesson progresses on the basis of some kind of material. Materials are used less in the early phases of a lesson than towards its end. Furthermore, teaching aids are used to a high degree: nearly one-third of the lesson is of this type. Teacher-orientedness was at its maximum in the two lowest forms and less in the sixth form. The study covered forms 1-6. All in all, in the three lowest forms the proportion of teacher-centred work methods was over 75 percent.

Furthermore, it was shown clearly that the proportion of group work was less than 2 percent, and the proportion of teaching discussion less than 4 percent of all the work methods. It is evident that if teaching materials are used around the middle of a lesson in up to 75 percent of the lessons observed, there is not much time left for pupil-oriented and interactive methods.

Naturally there are sources of error involved in the results, but the principal results have not been contested when they have been discussed. Rather, there seems to prevail unanimity that teaching materials dominate the practice of teaching in the manner described above. In any case, the empirical results summarized above clearly show that the curriculum reform has not been carried out in the manner desired. The curriculum stipulates quite unambiguously that teaching should be as pupil-oriented as possible instead of being classroom teaching of the traditional type. Thus, the practice does not correspond to the curriculum unless sufficiently low requirements are set for the sufficiency of pupil-orientedness. Whether the observed teacher-orientedness is desirable or not and what the reasons are for

the entire phenomenon with its dependence on teaching materials is another matter.

What do the summarized observations then show about teaching materials as means of implementing the curriculum? Evidently the inspection of the contents by the National Board of Education ensures that the contents of teaching correspond to the curriculum. But what is more important is to ponder why the teaching materials have not been prepared in the spirit of the curriculum. Obviously the tradition of teaching is so strong that it cannot be changed only by the didactic methods mentioned in the curriculum. For example, the framework factors have remained unchanged and the commercial nature of the teaching materials prevents daring applications. It is understandable that materials which do not attain the favour of teachers do not sell. Even though teacher-orientedness has been presented as being due specifically to materials, it of course cannot be due only to materials. A teacher's work methods naturally have an effect regardless of the materials.

Teaching materials as means of implementing the curriculum are on the one hand a sure tool for a reform in teaching, but its success seems to be restricted mainly to the contents of teaching. From this viewpoint it hardly matters if the teacher himself is not familiar with the curriculum. On the other hand, teaching materials do not seem to extend to a didactic reform of teaching; evidently this has not been the aim of the preparers of teaching materials, either. According to Finnish practice, anyone may prepare teaching materials, even though in practice the preparers are experienced teachers or researchers. It can be claimed that their primary purpose is not a didactic reform of teaching, nor does the publisher encourage them in it. The writers are not always even qualified for such reform, not to speak of the publisher being so. Thus it can be stated that revision of the teaching materials is a necessary prerequisite for the implementation of the curriculum, but it is not sufficient alone. In order to ensure didactic reform, other means are also necessary.

The implementation of a new curriculum is a process difficult to control, and undoubtedly teaching materials are of great importance in it. Could something be done to eliminate the current drawbacks? When this question is asked, the

problem is no longer merely didactic but also economic and political. The surest but at the same time the most authoritarian solution would be to entrust the preparation of the teaching materials to the same body that prepared the curriculum. Of course, a large number of experts in the field would then be required for subject-specific plans, but that is already the case. Anyway, this body would know what the intention of the formulation of the objectives and purposes of the curriculum is. Would such procedure lead to a situation in which there would be only one set of materials available for each subject to be taught? Not necessarily, but it would be highly probable.

At least in Finland the monopolization of the preparation of teaching materials would be a poor solution for the current publishers. No one has denied that the publishing of teaching materials is profitable, with the exception of fulfilling the needs of small specialized groups. If, however, the preparer of the curriculum would also prepare the teaching materials, the problem of selecting the materials would be eliminated. The problem of selecting is the greatest reason for the absurdity of the present situation, because it is in the selection process that the carrying out of the didactic reform encounters difficulties. On the other hand, selection also in a healthy way prunes out ideas which are impossible. In any case it would be possible to break the vicious circle which is due to the fact that the publisher does not dare make revisions for fear of poor commercial demand, which for its part weeds out reform-minded textbook writers, which again leads to increasingly more conventional solutions and certainly to traditional materials.

3. Significance of teacher education in the implementation of the curriculum

Curriculum reform often also involves a reform of teacher education. This was the case in both Norway and Finland during the time period under discussion. Often a great deal of hope is placed in teacher education, and there seems to be great faith in its power. This is so especially when no other means for reforming the teaching can be presented. I shall

discuss the role of teacher education, first from the viewpoint of actual teacher education and then separately from the viewpoint of supplementary teacher education.

Teacher education cannot be regarded as an independent and self-sufficient institution; it is always dependent on the social and and school-policy situation and on the school system. Teachers are educated for a certain concrete school practice, and they practice teaching for this purpose during their training. It is natural that future teachers are made familiar with the curriculum in force. There is nothing problematic in this practice; the problems appear only at a time of curriculum reform. The question can also be formulated this way: Will the trainers of teachers keep abreast with the reform or will the old practice continue in spite of the reform?

Teaching of didactics and practice teaching are those entities in teacher education in which the changes in education are manifested most readily. Regarding the former it can be said in general that it is highly theoretical and rather progressive by nature, the latter is rather based on the prevailing practice and is rarely experimental. However, in teacher education the curriculum should be raised to a sufficiently abstract level so that no student generation would receive education which is difficult to put to practice after a reform. This is the principle which has been observed in Finland when the education of teachers has been revised.

The implementation of the comprehensive school curriculum and its continued reform have constantly been reflected as changes also in teacher education. In Finland the education of teachers for the comprehensive school and the upper secondary school is of the same duration. All teachers, both in the elementary and intermediate stages of the comprehensive school and in the upper secondary school are required four years of university studies (160 study weeks). Such academic education includes independent training in research work. The objective is, in addition to practical training, to make the future teachers understand the teaching process profoundly. Especially the lengthening of the training of class teachers has aimed at a more profound understanding of the connection between the theory and the practice of teaching. Juhani Hytönen (1982) in Helsinki has focused on this question, and he has come up with an inductive-based model, according to

which the trend of integration is from practice to theory. Practice teaching is started as early as possible, progressing from small entities to more demanding combinations. The interaction of theory and practice is continual throughout the training, and at each stage it is possible to apply to practice the skills which have been studied theoretically. The training extends from an initial familiarization with the life of an individual pupil and a class to a longer period of independent teaching.

What is essential in the implementation of the curriculum is that the students are trained to use the curriculum in such a way that it will not be left an unfamiliar document for any. Even though this method seems self-evident, the practice has not been this clear always. The curriculum is presented as a document which has its place somewhere between research on teaching and the practice of teaching. This means that the preparation of curriculum is activity based on research, and that teaching is carried out by complying with the curriculum. At the same time the future teachers are given the idea that the teaching materials play a mediating role between the curriculum and the practice, whereby the independent position of teaching materials is contested.

Curriculum reform requires revision of teacher education, especially in the activities of the trainers of teachers. In itself the problem is similar to that of revising teaching practices. Nothing guarantees that an individual trainer of teachers adopt the way of thinking of the revised curriculum. The teacher of theoretical contents may even participate in the preparation of the curriculum, whereas the director of practice teaching is closer to the opinions in the field and thus closer to an ordinary teacher.

The curriculum reform is, of course, a central topic in the supplementary training of teachers. Since the theme was quite recently under discussion in this working group, I only make reference to the report given at that time (Nissen et al. 1981).

4. Didactic literature

In pondering how information regarding the curriculum reform could be disseminated among teachers we must remember the publishing activity through which new didactic and psychological literature is distributed to readers. A reform of the curriculum nowadays leads immediately to a revision of textbooks of didactics. It is true that a completely general textbook of didactics is an absurd idea; a textbook of didactics is always in some way linked with the prevailing practice. In Finland, textbooks of didactics have been of considerable importance in the implementation of the curriculum, mainly for two reasons. First, the writers of textbooks of didactics have themselves been involved in the preparation of the curriculum and have so familiarized themselves with the reform. Second, these books are originally written as textbooks for actual teacher education and for supplementary teacher education.

The writers of books on didactics in Finland have almost without exception been researchers in the field of education, having a distance of several years from personal teaching. For these reasons the books are theoretically weighted. They are well suited for the needs of actual teacher education, but their use in supplementary training is more problematic. Teachers who do not have a sufficient theoretical overall view cannot quite regard the approach as well-founded. This is in my opinion one important reason why the training should be sufficiently theoretical; it would facilitate subsequent adoption of revisions. If future teachers learn only practical instructions and methods of managing certain situations, they do not attain a capacity for transferring their skills.

The significance of the textbooks of didactics in carrying out a reform is obviously limited to actual teacher education. The demand for pedagogic literature in Finland is so scanty that it can be concluded that teachers do not purchase textbooks of didactics, at least not for themselves. However, these books have the potential training content at the ready, and so their utilization should be increased.

Guidebooks to teachers in connection with teaching materials come quite close to textbooks of didactics. Even though they may contain concrete lesson-specific hints, many of them also

contain passages which are comparable to textbooks of didactics. It is also known that teachers use these guides in preparing their classes. Thus we return again to the central importance of teaching materials in spreading information regarding the curriculum reform. However, it should be pointed out once more that revision of contents, subject by subject, is confirmed by the materials, whereas the didactic reform receives less attention also in the teacher's guides.

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MODALIZATION PROCESSES IN STUDENT BIOGRAPHIES

Rainer Kokemohr

My subject is informal verbal interviews with students of the Hamburg university in the field of social sciences and here particularly of psychology and the science of education.

My attention was drawn to those elements of students' phrases that are characterized by a certain vagueness or indefiniteness. These phenomena are very different. When analyzing the respective details of the interview answers we found particles like so, thus, you see, somehow, in some way or other etc. as well as patterns of elliptic speech (i.e. one or more incomplete sentences) and faltering or inconspicious switching from "I" to "we" up to omitting to indicate the acting centre.

1. My main idea is that this type of indefiniteness in the text might be an indicator of cognitive processes in connection with status passages (i.e. the transition from one social status to another) in accordance with B.G. Glaser and A.L. Strauss. At the beginning of their university career normally students have to look for a new frame of orientation. Before starting with their university courses they relied on lines of orientation that have been formed by their ordinary everyday interactions. Therefore these lines of orientation have an interactional relevance first of all. In simplified terms, students trust in these orientating lines due to their experience gained in interaction of their social sphere.

2. When studying at the university they encounter other types of orientation lines causing a gradual but significant change. Here - more than in everyday life - the orientation lines tend to depend on a scientific frame e.g. theoretical models wherein propositions become relevant. Consequently the lines of orientation have a scientific relevance primarily. We trust in them since they proved their usefulness in dealing with scientific matters. If this is correct there must be a process of transition - briefly proceeding from an everyday life orientation to an orientation basing on science. And indeed, we

19

have observed that the linguistic indefiniteness is increasing when students talk about their problems as to orientate themselves when entering the university involved in their status passage. It is this particular process of transformation that I am interested in.

3. When investigating the phenomena of transformation among other things we have to ask about the linguistic structure of indefinite elements in speech, about the cognitive function of indefiniteness and about the social context causing this. This brings about three question areas: the linguistic, the cognitive and the social area. Since it is impossible to focus on all three simultaneously or as a whole and with regard to my humble abilities I'll concentrate on the linguistic area whereas only some comments will be given regarding the cognitive and social sphere. Therefore I am looking for a linguistic approach to interactional speech events that can be interpreted as transforming procedures in the biographical context of a status passage.

4. Before analyzing the interview text itself, I'll give some details regarding my analysis, i.e. its theoretical frame of reference.

a) Its theoretical frame of reference bases on one of the main ideas of Alfred Schütz and the phenomenological sociology. On this condition and within this context the phenomenon of transformation can be described as follows: in everyday life people adhere to "finite provinces of meaning". There are, of course, different provinces of meaning according to the different fields of interaction e.g. the social area, the sphere of art, of phantasy, the world of fancy, the area of scientific models or the sphere of children's games as Schütz pointed out in his treatise "On multiple realities". Following Schütz each province of meaning is characterized by a "particular cognitive style" and whenever we want to switch from one province of meaning to another one, a "leap" has to be made: a thesis which is related to the notion of the cognitive style. Therefore we may argue that where a leap is required, no further details regarding the act of passing from one province to another can be given. But that would be insufficient. It must be possible to look into the conditions of

leaping and the leaping process itself. The theory of Alfred Schütz provides some hints already. In the posthumous "Strukturen der Lebenswelt" vol. II finished by Thomas Luckmann appears the conception of transcendency. Herein the possibility of representing a meaning included in the province B within the frame of province A is mentioned. So Schütz and Luckmann suppose that the process of passing from one province to another must follow a rule. But they don't specify this rule.

b) At this stage I would like to draw your attention to Karl Bühler and his still modern linguistic theory of 1934. Bühler's linguistic theory is very useful in view of investigating the process of the linguistic transition when passing from one province of meaning to another because in his opinion this is a pragmatic process of orientation by linguistic means. Bühler follows a dualistic concept. He argues that there is a difference between linguistic elements of indication and denomination. The first group comprises especially the so-called indexical expressions which we must use in order to attach a proposition to a distinct situation. This group is most important for changing the frames of orientation by linguistic means.

c) Within the area of indexical elements Bühler distinguishes and describes different frames of orientation. The first one refers to the empirical situation of the speaker-hearer interaction itself. Being asked about the way to the station, normally the hearer will show the way by pointing out the direction with his index finger. This is possible as long as the empirical situation is in accordance with the perceptual system of orientation. The frame of orientation regarding the area of "showing" can be the empirical situation of "real" perception.

d) However, there are other cases, e.g. if the speaker wants to inform the hearer of an incident that happened in front of the station in another town yesterday. Now he can't any longer point at the respective place with his index finger. But the language allows to represent a model of the imagined incident and its situation. We do this by using linguistic elements in order to point not at a real situation but at a situation remembered by the speaker which must be imagined by the hearer. Bühler calls this type of assumed situation the "phantasma".

e) So we may speak of a phantasmatic orientation. Within the frame of phantasmatic orientation the indexical expressions refer no more to elements of the real word but to words, sentences, expressions or suppositions of the speech context. Textbooks of rhetoric often say that indexical expressions turn into anaphoric or kataphoric elements due to their referring to distinct passages of the text. Those elements that are referring to text components of the past are called anaphoric elements whereas kataphoric elements refer to text components of the future.

In short and more precise the thesis maintains: a speaker who wants to tell something has to inform the hearer about the frame of reference. As long as his telling refers to a real situation he can easily rely on the deictic procedure i.e. he can use indexical terms to draw the hearer's attention to the respective subject. Apart from indexical terms he can use audible or visible signs enabling the hearer to identify the object in question. This can be easily accomplished because the speaker can trust in the hearer's correct comprehension. However, the deictic procedure has to be changed if the speaker turns from the perceptive to the phantasmatic sphere assigned by the text. Here the speaker can use deictic procedures to draw the hearer's attention to ideas, propositions or knowledge mentioned in the preceding or following text.

Up to now we can say that we use indexical terms to refer to either noticeable objects or linguistic elements given by the context. We use indexical expressions to orientate the hearer by defining the frame of reference.

f) In a discussion about the linguistic theory of Karl Bühler, the German linguist Konrad Ehlich pointed out that there is a difference between deictic and phoric procedures. The deictic procedures serve to produce a frame of orientation whereas by means of phoric procedures the hearer (as well as the speaker himself) is caused to adhere to the frame of orientation given by the preceding or following text. Thus the indexical expressions can function as phoric (anaphoric or kataphoric) elements due to their references to linguistic elements in the context.

g) In view of pragmalinguistics this is a very interesting point: By deictic procedures we cause the hearer to produce another frame of reference whereas the phoric elements

(anaphoric or kataphoric) are used to make the hearer cling to a given frame of reference. The German version of my paper gives more details in view of this difference which is a very difficult subject, indeed, and hard to explain for one who doesn't master the English language efficiently. However, in view of that what I want to demonstrate, I hope it will be sufficient to inform you of the main idea.

It is necessary to recognize the nature of phoric procedures in view of that what I want to show in the interview text. What are the characteristic features of a phoric procedure? In my answer I'll concentrate on an anaphoric element that is included e.g. in the utterance "The man with the green hat is the husband of aunt Mary? He is a forester." In this text "he" is the anaphoric element that refers to the phrase "the man with the green hat". Therefore this type of reference in a text can be called a substitutional relation.

The procedure of substituting can be regarded as a linguistic as well as a cognitive process. By anaphoric elements like the "he" of our example we persuade ourselves as well as our hearer to trust in the fact that the word as it is represented in the substituted phrase will continue to exist. In a lax way we may say that anaphoric elements help to preserve our illusions about the world, its provinces of meaning and about ourselves as members of a social world.

h) Now I should like to introduce a further differentiation, i.e. there are different types of anaphoric or substitutional elements. When speaking of anaphoric elements we think usually of elements - like the word "he" in our example - that are defined by a definite reference. But there are - as pointed out at the beginning of this paper - other types of expressions that have an indefinite reference. Therefore we have to distinguish between definite and indefinite references within phoric procedures. The litte word "so" when used in a special context is an example for an indefinite reference. Already in the beginning I mentioned that I found this particle surprisingly often in interviews with students.

i) You may be surprised to see "so" defined as an anaphoric-substitutional element. In general it belongs to the series of modal adverbs and I think that is correct. But something more can be added in this respect. In general the word "so" refers to a corresponding element: so - as (it is so as I told you

before) or so - that (the statement was so clear that is couldn't be misunderstood). However, in everyday conversation the corresponding phrase (as I told you; that it couldn't be misunderstood) is left out rather often. In many situations where two persons when meeting utter only "so", in German this is in the meaning of "so as we know by experience" or "so as you see" or "so as he told us" etc. Thus the little word "so" when uttered without a corresponding element doesn't refer any more to a special corresponding element but the whole class of interpreting elements of possible reference that could be combined with the word "so" in a given context. Due to this we suppose that there is a multitude of corresponding elements with a variety of possible references. The elements of indefinite reference are those which due to non-utterance of the corresponding element refer to a variety of possible corresponding elements.

k) Centring again on the capacity of "so" I should like to point out that this as a linguistic element is able to change between definite and indefinite reference, i.e. combined with a corresponding element it has a definite reference, if not, the reference is indefinite. The function of linguistic elements like "so" depends on their possibility of changing between definite and indefinite reference which is rather essential in view of problem solving processes involved in the course of status passages.

5. This will be demonstrated by means of some phrases of the students' interview text which causes some problems as to the translation. In a very precise analysis of the linguistic and cognitive structure of interviews we depend on the intuition of the native speaker. Therefore this English version will be restricted to the analysis of the main structure of the problem-handling process together with the recapitulation of the status passage.

The interview with Christiane is very interesting. During the first 15 minutes Christiane deals with her early experiences and situations when starting her university studies. It can be supposed that by speaking about these she reactivates the - at that time unsolved - problems of her orientation. With regard to the linguistic definiteness three different parts of the text can be distinguished. In the first one the anaphoric elements

like "so" tend to a definite reference, whereas in the second one they appear much more often, tend to indefiniteness and sometimes even stuttering or repeating can be noted. In the last part - after a remarkable crisis of orientation indicated by elliptic speech - the anaphoric elements of Christiane's interview turn back to a definite reference.

a) The first part is characterized by Christiane's talking about her first interactional situation in a university course which she liked very much due to its agreeable atmosphere. In this course the students had to talk about their educational experience in colloquial speech. Within this sequence the anaphoric "so" refers definitely to linguistic elements representing experiences of everyday life in view of pedagogical interaction.

But already in the second part of this sequence, phenomena appear that indicate a decrease in the definite reference. When speaking about her orientation troubles in the following courses, elliptic utterances and a change in the acting centre from "I" to "we" can be noted. It seems as if Christiane prefers to reduce the risk of orientation by hiding her individual self behind the "we"-group of her fellow students.

b) In the second part Christiane talks about her further studies and her endeavours to organize the individual course of her study. She describes particularly that situation that irritates students of social sciences at German universities due to the lack of regulations for a course of study in this field. Christiane's comments on these orientation problems are characterized by two different moves. On the interactional level she tends to turn from the "we" of the group to a timid "I", i.e. she talks about her personal feeling including a slowly increasing encouragement to self-determination in this phase of her studies. On the propositional level, however, i.e. the level of scheming, analyzing and evaluating the subjects of her studies she doesn't succeed in developing a personal curriculum. This tentative situation is characterized by the ambiguity of a beginning self-determination in the interactional field combined with a still existing lack of orientation in the field of subjects.

In this part of the text the "so" appears very often and combined with changing functions. It is one of the linguistic elements Christiane uses to persuade herself to enter into a

new frame of orientation. This searching process may be called a tentative process and to give you a better idea hereof, her utterance has been translated:

> "Mhm you see, it has become so, so that due to that I have become a bit more self-confident --- now more often I say something because I feel I can see some matters somewhat more clearly and I also realize when --- when I have looked more closely into some matters that afterwards I --- that I - just so - how shall I explain this now --- so, now well in any case that more often I dare say something or that I --- if I have prepared a certain chapter --- that I then feel a bit more confident to contribute something so, in some way ---."[1]

c) Here Christiane still fails to reach a new frame of orientation. But the changing function of "so" indicates a change in the phoric procedure likewise. Simplified: on the interactional level the "so" refers to Christiane's position in the social group. Here the "so" serves to stimulate herself as well as the hearer into maintaining the orientation frame of the group. But on the propositional level the "so" carries Christiane's search for a new frame of orientation.

After experiencing a new interactional acceptance Christiane tends again to a more definite reference.

6. My thesis is that some linguistic particles are able to change between definite and indefinite reference and it is just this ambiguity that allows us to trust in the continuity of the respective orientation frame. Due to this trusting we are able to develop tentatively new categories of orientation that are needed to solve those cognitive problems involved in the status passage. This transition from one frame of orientation to new one can be called a modalization process as mentioned in the title of my paper. This kind of process signifies a change in the way of thinking of and speaking about something.

To prove this thesis we could demonstrate how Christiane returns to definite references in a later part of the interview. She does so after she has got past her crisis of orientation in the status passage. In that part she talks about propositional and interactional orientations.

7. Another possibility to prove the thesis would be to analyze interviews with other students in view of the status passage.

In my opinion it will be most interesting to analyze a counterpattern and I am pleased to have one in our interviews. The brief description is that this student tends to persist in maintaining the definite references and to avoid any crisis of orientation. That means he tries to avoid the trouble of cognitive insecurity involved in status passages. He tries to preserve his preuniversity orientation. Since his social interaction is impaired due to personal problems which have to be discussed in the group, he is compelled to reduce his uncompromising definiteness of reference. Contrary to Christiane he tries to avoid every linguistic ambiguity. Therefore nearly no indefinite elements of phoric procedures can be noted. Since it is impossible to maintain a scheme of interactional orientation in case of failing social relations, it is likewise impossible to preserve definite references. In this situation it is demonstrated what - in spite of that - one could do to avoid indefiniteness and a crisis of orientation. Instead of using linguistic elements that are ambiguous as to their definite or indefinite reference like "so", he turns to elements of explicit indefinite reference like e.g. "anyhow". Using "anyhow" in this way involves that the search for new orientations becomes more difficult. It seems that such a behavior prevents or reduces considerably the possibility to alter the cognitive structures in order to try tentatively new categories, i.e. the possibility of a modalization of learning in status passages.

8. What does my analysis mean for biographical research?

1) First I have to point out that I haven't yet dealt with the interactional conditions of phoric procedures in connection with the modalization process. It can be supposed however, that decreasing the rigidity of cognitive structures by means of linguistic indefiniteness depends on good interactional conditions as well and that this has to be considered as an interactional process. The two examples given don't tell much about the biographical career of the two students. But if we could find out that the analyzed schemes are typical for the speaker's orientation, we may suppose that there are corresponding biographical phenomena. And indeed this could be shown in the case of the second example.

2) It seems that the function of linguistic elements with indefinite reference is very important in view of problem-solving procedures as they are required in status passages. These elements seem to facilitate the transition from failing cognitive structures to a search for new problem-solving categories by going back to - what may be called - the passive memory. In citing Piaget we suppose that linguistic inde-finiteness plays an important role in the combined process of assimilation and accomodation. Therefore it is justified to describe the cognitive change from one province of meaning to another one in accordance with Schütz as a leap. Due to our finding we now have come to a thesis about the linguistic aspect of leaping as a modalization of the categorical learning in biographical careers.

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[1] Mhm, also es ist so – so geworden, dass ich dadurch ein bisschen selbstsicherer geworden bin dass ich auch eher mal was sag, weil ich auch denk, dass ich einige Sachen jetzt auch ein bisschen besser durchschaut hab oder dass ich auch so merk wenn wenn ich mich mit was näher beschäftigt hab, dass ich das na, so wie ich jetzt sagen soll, so --- na --- also jedenfalls so dass ich mich öfter schon mal trau, was zu sagen oder dass ich --- wenn ich wenn ich 'nen Teil vorbereitet hab, dass ich mich da auch 'nen bisschen sicherer fühl, das dann schon irgendwie so reingeben mag ---.

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PROBLEMHAFTER UNTERRICHT IM FACH PHYSIK MIT DEM ZIEL DES AUSLÖSENS SCHÖPFERISCHEN LERNENS

Hansjoachim Lechner

Physikunterricht im Gesamtensemble der Unterrichtsfächer

Untersucht man die Bedeutung des Physiklehrganges im Rahmen der Allgemeinbildung, so ist in erster Linie herauszustellen, dass die im Physiklehrgang behandelten Inhalte und Arbeitsweisen wesentlich zur Persönlichkeitsentwicklung beitragen. Durch die Behandlung physikalischer Fragestellungen und Erscheinungen

- wird das logische Denken im Zusammenhang mit konkreten Sachverhalten entwickelt,
- wird die Herausbildung weltanschaulicher Positionen gefördert. Dazu gehören auch tiefere Einsichten in Naturvorgänge,
- wird das Verständnis, aber auch die Wirksamkeit naturwissenschaftlicher Erkenntnisse für technische und technologische Entwicklungen gefördert,
- wird das tiefere Verstehen biologischer, chemischer, geografischer Erscheinungen ermöglicht.

Diese grosse Bedeutung der Physik für die Allgemeinbildung, die auch die Stellung der Wissenschaft Physik im Gesamtensemble der Wissenschaften widerspiegelt, ist ein wichtiger Grund, weshalb in den sozialistischen Ländern Physik als obligatorisches Fach bis zum Abitur nach staatlich vorgegebenen Lehrplänen gelehrt wird. Dabei wird die Auswahl der durch den Lehrplan vorgegebenen Inhalte durch die Trendentwicklung in Wissenschaft und Technik bestimmt und in verschiedenen Zeitabständen auch aktualisiert. Die Lehrgänge unserer polytechnischen Oberschule beinhalten nach wie vor Inhalte der klassischen Physik, da an ihnen: erstens die wichtigsten Bildungs- und Erziehungsziele zu realisieren sind, zweitens der überwiegende Anteil der technischen Einrichtungen der Produktion auf diesen Gesetzmässigkeiten beruht und drittens die Inhalte verständlich für alle Schüler darstellbar sind.

In den letzten Jahren wird das Konzept der Allgemeinbildung insofern verändert, dass die obligatorischen Unterrichtsfächer durch einen fakultativen Kurs ergänzt werden. Das bedeutet, zu den obligatorischen Unterrichtsfächern kann der Schüler einen oder zwei zusätzliche Kurse wählen, die seinen Interessen und seinen Begabungen entsprechen. Für die Physik sind dies für die Klassen 9 und 10 Kurse zu den Themen "Technische Anwendung der Physik" und "Elektronik", für die Klassen 11 und 12 "Festkörperphysik", "Elektronik" und "Elektrische Messung nicht-elektrischer Grössen". In diesen Kursen können die Begabungen und Fähigkeiten besonders gut entwickelt werden. Durch die relativ kleine Zahl an Teilnehmern (bis zu 15) und durch das Prinzip der Freiwilligkeit ist eine hohe Effektivität gegeben.

Die Leistungen der Schüler auf dem Gebiet der Physik können trotz vieler Fortschritte noch nicht genügen. Dabei muss man davon ausgehen, dass beim Schüler nur dann akzeptable Leistungen erreicht werden, wenn die Schüler auch Freude an der Beschäftigung mit der Physik haben. Sollte dies vordergründig nicht der Fall sein, so muss zumindestens keine Abneigung für dieses Fach vorhanden sein. Dies ist aber z.Z. bei uns nicht immer der Fall. Bei Befragungen zu Lieblingsfächern ordnet sich die Physik immer im letzten Drittel ein. Bei einer Befragung von Schülern der Klasse 8 äussern ca. 45 % Zustimmung zum Unterrichtsfach Physik, während ca. 25 % eine ablehnende Haltung zum Ausdruck bringen (Brandt, 1986). Von den 12 Fächern ordnet dieselbe Schülergruppe Physik an der 9. Stelle ein. Ein wesentlich differenzierteres Bild bringt eine Betrachtung getrennt nach Geschlechtern. So ordnen die Mädchen Physik an der 11. Stelle ein, während die Jungen Physik an die 5. Stelle setzen. Dieses Aussage wird dadurch gestützt, dass nur 18 % der Mädchen Physik als ihr Lieblingsfach betrachten, während 82 % Physik ablehnen (bei den Jungen 43 % Zustimmung, 57 % Ablehnung). "Mir gefällt der Physikunterricht" bejahen 9%, der Mädchen, aber 22 % der Jungen (Ablehnung 16 % der Mädchen, 11 % Jungen). 11 % der Mädchen und 35 % der Jungen verneinen die Aussage "Ich halte den Physikunterricht für langweilig". Diese geschlechtsspezifischen Unterschiede sind bei weiteren Veränderungen im Physikunterricht unbedingt zu berücksichtigen. Interessant sind detailliertere Angaben zu dem genannten Themenkreis, die durch Exploration einer Stichprobe gewonnen werden.

Die Schüler wünschen sich als Verbesserungen im Physikunterricht mehr Experimente; Möglichkeiten der Themenbeeinflussung durch die Schüler, stärkere Verbindung mit dem täglichen Leben und eigenen Erfahrungen; weniger Theorie und mehr Darstellungen am konkreten Beispiel; mehr Zeit für Diskussion; grössere Flexibilität im Stundenablauf (auf Randfragen und Probleme der Schüler eingehen und nicht so "stark nach Lehrbuch"); mehr Zeit beim Experimentieren.

Diese Äusserungen der Schüler zeigen, in welcher Richtung eine Veränderung des Physikunterrichts erfolgen muss. Es sind didaktisch-methodische Veränderungen vorzunehmen, die für den Unterricht stärker den heranwachsenden Jugendlichen mit seinen Problemen berücksichtigen und nicht eine Fachsystematik und ein hochschulgemässes Darlegen des Inhaltes zur Grundlage des Unterrichts machen. Es ist notwendig, den Schüler stärker zum SUBJEKT und weniger zum OBJEKT im Unterricht zu machen. Dies bedeutet, dem Schüler muss u.a. Gelegenheit im Unterricht gegeben werden,

- Ideen zu äussern und mit dem Recht auf Irrtum,
- Fragen zu stellen und Probleme aufzuwerfen sowie
- historische Erfindungen und Entdeckungen nachzuvollziehen (im Sinne von subjektiv Neuem).

Problemhafter Unterricht, so wie er von uns verstanden wird, eröffnet dem Schüler diese Möglichkeiten. Dabei werden an die Schüler hohe Forderungen gestellt, schöpferische Lernleistungen zu erbringen. Doch zeigen unsere Untersuchungen, dass diese Form der Unterrichtsgestaltung nicht nur die "zensurenmässig guten Schüler" anspricht, sondern durch eine stärker motivierende und die Tätigkeit der Schüler stimulierende Unterrichtsgestaltung ein grosser Teil der "zensurenmässig leistungsschwachen Schüler" angesprochen wird. Die Einstellung der Mädchen in Klasse 8 verbesserte sich bei der problemhaften Unterrichtsgestaltung leicht, während in parallelen Vergleichsklassen ohne eine solche Unterrichtsgestaltung ein starker Abfall des Interesses an der Physik zu verzeichnen war. Gleichzeitig verbesserten sich die Leistungen dieser Schüler merklich. Es wurde aber auch deutlich, dass solche Leistungen nur erreicht werden können, wenn

- eine systematische Befähigung zu den naturwissenschaftlichen Denk- und Arbeitsweisen erfolgt,
- das notwendige Grundwissen und Grundkönnen vorhanden ist,
- die notwendigen Grundfertigkeiten beherrscht werden.

Wie ist problemhafter Unterricht zu charakterisieren?

Wir kennzeichnen problemhaften Unterricht in den naturwissenschaftlichen Unterrichtsfächern folgendermassen:

Problemhafter Unterricht in den naturwissenschaftlichen Fächern ist ein entwicklungs- und erkenntnisprozessgerechter Lern- und Lehrprozess, der sich auszeichnet durch Variantenreichtum des Vorgehens, durch besondere Förderung der Aktivität der Schüler, durch Massnahmen zum Auslösen und Wachhalten der Lernmotivation und in dessen Mittelpunkt das Problembearbeiten (Problemstellen und Problemlösen) steht.

Dabei bedeutet *erkenntnisprozessgerecht*, dass die Vermittlung oder Erarbeitung der physikalischen Inhalte der Logik des Erkenntnisprozesses folgt. So z.B. die Erarbeitung physikalischer Begriffe, der physikalischen Gesetze oder auch der Anwendung physikalischer Erkenntnisse auf technische Sachverhalte. In allen Fällen haben sich ideale Erkenntniswege herausgebildet, z.B. das induktive oder das deduktive Vorgehen bei der Gesetzeserarbeitung, abhängig von den objektiven Bedingungen und der individuellen Leistungsbereitschaft der Klasse. Eingeschlossen in solche idealen Erkenntniswege sind z.B. die experimentelle Methode oder die Modellmethode.

Doch die Gedankenführung der Schüler unterwirft sich nur in den seltensten Fällen dieser Idealvorstellung, ausgenommen die Tatsache, der Unterricht wird - genetisch aufgebaut - in so kleinen Schritten gegangen, dass alle Schüler bei Abweichungen *sofort* auf diesen Weg wieder eingestellt werden.

In einer solchen Prozessgestaltung werden die leistungsstarken Schüler unterfordert und die leistungsschwachen Schüler rezeptieren *problemlos* die Inhalte.

Problemhafter Unterricht wird deshalb von uns auch durch das Adjektiv *entwicklungsgerecht* gekennzeichnet. Dies sagt aus, dass die psychischen Altersbesondersheiten stärker zu berücksichtigen sind, aber auch die Besonderheiten der jeweiligen Erfahrungsbereiche (Stadt - Land, Arbeit in Produktionsbetrieben) beachtet werden sollten.

Den Schülern wurde am Ende der 8. Klasse (nach der Behandlung des Gleichstromkreises) folgendes Experiment vorgeführt:

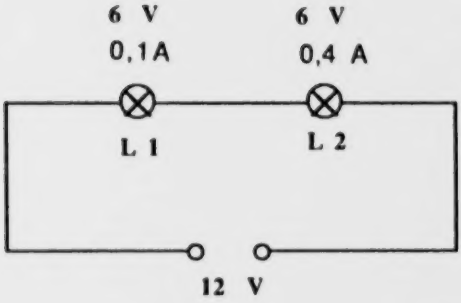

Abb. 1.

Die Schüler wurden aufgefordert zu erklären, warum nur eine der beiden Lampen leuchtet, obwohl es sich in beiden Fällen um 6 V-Lampen handelt.

Hier drei typische Antworten:
- Die Lampe 2 ist kaputt, da sie nicht leuchtet.
- Die Lampe 1 verbraucht allen Strom, so dass Lampe 2 keinen Strohm mehr erhält.
- Die Lampen 1 und 2 unterscheiden sich im Widerstand, so dass Lampe 1 den Strom begrenzt und Lampe 2 die zum Glühen notwendige Stromstärke nicht erreicht wird.

Die erste Antwort ist für den Physiklehrer unannehmbar. Doch was sind die Begründungen der Schüler? Die Schüler begründen ihre Aussage mit dem Vergleich zur elektrischen Weihnachtsbaumbeleuchtung. Die Lampen sind in dieser Schaltung auch in Reihe geschaltet und beim Ausfall (sprich: beim Kaputtgehen) leuchten die anderen Kerzen weiter. Der Grund, den die Schüler aber nicht kennen, besteht darin, dass bei Anliegen der vollen Spannung von 220 V der Glühfaden durchbrennt und ein in der Fassung eingebauter Kitt durchschlägt. Er bildet einen Ersatzwiderstand. Aus dieser Sicht gewinnt die erste Schülerantwort ein völlig anderes Gewicht. Die Schüler haben einen richtigen Vergleich angestellt, wenn sie auch keine vollständige Bedingungsanalyse durchgeführt haben.

Oder nehmen wir die zweite Antwort. Der Vergleich mit der Wasserleitung - auch bei Beachtung des umgangssprachlichen Wortes "VERBRAUCHER" - führt schnell zu einer solchen Aussage. Es wird auch in diesem Beispiel deutlich, dass wir es im Physikunterricht häufig damit zu tun haben, dass Alltagsvorstellungen oder Alltagsbegriffe mit den naturwissenschaftlichen/-physikalischen Begriffen und Aussagen in Widerspruch stehen.[1]

Alle Erfahrungen und alle psychologischen Ergebnisse zeigen, dass solche Alltagsvorstellungen oder Alltagsbegriffe nur in der aktiven Auseinandersetzung der Schüler mit diesen Inhalten überwunden werden können, aber nicht durch verbale Äusserungen des Lehrers. Es wird deshalb in unserem Unterricht angestrebt, die Gedanken, Ideen der Schüler mehr als produktives Element im Unterricht zu nutzen, ohne eine systematisch zielgerichtete Arbeit gemäss Lehrplan aufzugeben.

Die Motivierung ist ein weiterer wichtiger Bestandteil des problemhaften Unterrichts. Für besonders Interessierte, z.B. für den zukünftigen Physiker, Ingenieur, Elektroniker usw. ist der Inhalt schon allein motivierend, aber für die Mehrzahl der Schüler - unter dem Aspekt der Allgemeinbildung und der Persönlichkeitsentwicklung - ist es notwendig, die Lerninhalte für den Schüler persönlich bedeutsam zu machen z.B. durch den Bezug zur Erfahrungswelt der Schüler oder auch zur Nützlichkeit für die Gesellschaft.

So kann z.B. im Abschnitt "Wärmeübertragung" die physikalische Problemstellung "Übertragung von Wärme zwischen Flüssigkeitsmengen" in der Abbildung beschriebenen Form (Abb. 2) für die Schüler bedeutsam gemacht werden durch den Hinweis auf den modernen Milchtopf (Abb. 3). Wird in einer 8. Klasse auch noch emotional der Einsatz dieses Topfes im Vergleich zum einfachen Topf (Überkochen) geschildert, so ist eine besonders grosse Wirkung zu erreichen.

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[1] Siehe auch: Erätuuli, M. Wie können sich die finnischen Schüler der Schuljahre 7 bis 9 die alltäglichen Phänomene der Wärmelehre erklären. Research Report 17. Department of Teacher Education, University of Helsinki. 1984.

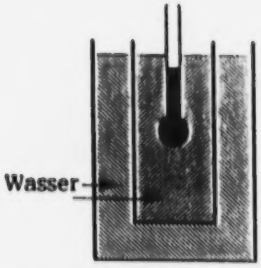

Abb. 2

Abb. 3

Aber problemhafter Unterricht reduziert sich nicht auf die beschriebenen Elemente, sondern die Entwicklung zu Schöpfertum auf naturwissenschaftlichem Gebiet schliesst die vollständige Bearbeitung von Problemen bzw. die Befähigung der Schüler zur weitgehend selbständigen Bearbeitung von naturwissenschaftlichen und naturwissenschaftlich-technischen Problemen in Zusammenhang mit den Lehrplaninhalten ein.

Problemtypen im naturwissenschaftlichen Unterricht[1]

Unter einem Problem ist ein System von Aussagen und Aufforderungen bzw. Fragen zu verstehen, bei dem der vorhandene Erkenntnisstand nicht ausreicht bzw. kein Algorithmus bekannt ist, um das in den Aufforderungen gestellte Ziel menschlicher Tätigkeit zu erreichen. Probleme können durch Reproduzieren und einfaches Kombinieren vorhandenen Wissens allein nicht gelöst werden, sondern erfordern die Suche nach noch Unbekanntem, Neuem unter Berücksichtigung mehrerer Lösungsmöglichkeiten, also schöpferische Tätigkeiten. In der Literatur sind mehrere Klassifizierungen der Probleme zu finden. Für den naturwissenschaftlichen Unterricht hat sich eine Klassifizierung nach den Haupttätigkeiten als zweckmässig erwiesen. Wir unterscheiden deshalb (Kurze et al., 1982):

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[1] Kurze, M.; Mörtz, R.; Jäckel, D.; Müller, A. In: Problemhafte Unterrichtsgestaltung in den Fächen Biologie - Chemie - Physik. Berichte der Humboldt-Universität Berlin Heft 12, 1982.

35

a) Beschreibungsprobleme

Sie zielen auf Aussagen zur genaueren Abbildung eines Sachverhalts, auf die Aufdeckung bisher unbekannter Verläufe. Darunter ist auch das Aufdecken von Gesetzen zu nennen. Dabei kommt es sehr häufig zur induktiven experimentellen Erarbeitung der Abhängigkeit physikalischer Grössen und über grafische Darstellungen oder Wertetabellen zur mathematischen Formulierung des Gesetzes.

b) Erklärungsprobleme

Sie zielen auf Aussagen, die zu einer Erscheinung die zu grundeliegenden Gesetze ermitteln und aus ihnen die Erscheinung logisch ableiten.

Typische Problemstellungen sind: Warum ---, obwohl --? Worauf beruht ---? Welche Ursachen hat ---, obwohl ---?

In diesem Problemtyp sind alle physikalischen Paradoxa enthalten. Das schon genannte Beispiel der in Reihe geschalteten Lampen gleicher Nennspannung, aber unterschiedlicher Leistung ist ebenfalls hier einzuordnen.

c) Voraussage- oder Prognose-Probleme

Sie zielen auf Aussagen über noch unbekannte Merkmale, Verläufe, Erscheinungen, zu erwartende Ereignisse.

Typische Problemstellungen sind: Was wird --- geschehen, wenn ---? Wie müsste --- sein? Welche Folgen hat ---, wenn ---?

Beispiel:

Ein vertikaler Federschwinger besitzt einen Permanentmagneten als schwingende Masse. Wie wird der Schwingungsvorgang verlaufen, wenn der Schwinger einmal frei, zum anderen Mal in einer Messingröhre schwingt? (Abb. 8)

Ausgehend von der Kenntnis wirkender Gesetze wird auf mögliche Erscheinungen oder Ereignisse geschlossen.

Da die Bedingungen sehr unterschiedlich sind und in der Regel auch nicht alle sofort zu erfassen sind, ist eine Überprüfung der Voraussage notwendig.

d) Konstruktions-Probleme

Sie zielen auf Aussagen über geeignete Prinzipien, Verfahren und Mittel zur technischen Anwendung naturwissenschaftlicher Sachverhalte.

Dies schliesst auch die Möglichkeiten zur experimentellen Überprüfung mit ein.

Typische Problemstellungen sind:
Welche Möglichkeiten der technischen Anwendung oder experimentellen Überprüfung gibt es für ---? Welche Parameter sind zu beachten, damit ---? Wie müsste eine technische Anlage, Apparatur, Experimentieranordnung aufgebaut sein, um---?

Zu diesem Problemtyp gehören z.B. alle Messverfahren, bei welchen nichtelektrische Grössen elektrisch gemessen werden. Aber auch die Konstruktion eines Generators, eines Transformators oder einer Dezimalwaage gehören zu diesem Problemtyp.

e) Wertungsprobleme

Sie zielen auf die Bewertung von Sachverhalten bezüglich ihrer gesellschaftlichen Bedeutsamkeit, Nützlichkeit, Notwendigkeit, ihrer Beziehung zu Wertprinzipien und Normen des Verhaltens.

Dabei kommt es bei Wertungs-Problemen im naturwissenschaftlichen Unterricht darauf an, dass auf der Basis der Kenntnisse über den naturwissenschaftlichen Sachverhalt (ggf. erarbeitet über ein Erklärungs- oder Voraussageproblem) die Wertung vorgenommen wird, d.h. der Bezug zu den gesellschaftlichen Normen hergestellt wird.

Typische Problemstellungen sind:
Wie ist -- zu beurteilen wenn man berücksichtigt, dass --? Welcher Nutzen oder Schaden ---, wenn man berücksichtigt, dass ---? Welche Schlussfolgerungen für das Handeln ergeben sich, wenn man berücksichtigt, dass ---?

Beispiel:
In eine Stanze soll eine automatische Verriegelung eingebaut werden. Zur Auswahl stehen eine mechanische Verriegelung, eine Fotodiodenschaltung, ein Relais, einmal als Ruhestromrelais zum anderen als Arbeitsstromrelais.
Welche der Schaltungen würdest du einsetzen, wenn man berücksichtigt, dass das Arbeitsstromrelais weniger Energie braucht, dass ein Ruhestromrelais aber eine höhere Sicherheit gibt?

37

Quellen und Arten des Herbeiführens von Problemsituationen[1]

Eine besondere Rolle für den erfolgreichen Unterrichtsprozess spielt die Auslösung der Problemsituation. Dabei gehen wir davon aus, dass die Probleme gedankliche Gebilde sind, deren objektive Korrelation die Problemsituationen sind. Im Unterricht liegt eine Problemsituation dann vor, wenn die Schüler bei der Lernarbeit auf Widersprüche und Erkenntnislücken stossen, wenn sie Schwierigkeiten und Barrieren überwinden müssen.
Als 'Quellen' für Problemsituationen sind zu nennen:

- Widersprüche in physikalischen Objekten und Prozessen selbst (dazu gehören alle Paradoxa),
- Widersprüche im Denken und Handeln von Menschen,
- Widersprüche im Erkenntnisstand der Schüler, die bei der Konfrontation mit dem Lernauftrag auftreten oder durch Alltagserfahrung hervorgerufen werden.

  Diese Quellen können in unterschiedlicher Weise an die Schüler herangetragen werden, z.B.
- durch Aufdecken von physikalischen Erscheinungen mit objektivem Widerspruchscharakter, die beim Schüler das Bedürfnis nach Klärung auslösen,
- durch Experimente, die zu unerwarteten Effekten führen (dabei ist beim Schüler in der Regel eine Erwartungshaltung anzuregen),
- durch Bekanntmachen mit Praxissituationen, deren naturwissenschaftliche Grundlagen aufgedeckt und erklärt werden müssen,
- durch Bekanntmachen und Auseinandersetzen mit unterschiedlichen wissenschaftlichen Theorien und Hypothesen; Bewusstmachen und Nachvollziehen wissenschaftshistorischer Problemsituationen.

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[1] Kurze, M.; H. Lechner: Aktivierung schöpferischen Lernens durch wirksame, methodisch variantenreiches Problemstellen. In: Pädagogik, Berlin 35 (1980) 12, s. 974-983.

Etappen des Problembearbeitens[1]

Beim Problembearbeiten lassen sich zwei Hauptetappen unterscheiden: das Problemstellen und das Problemlösen.

Das Problemstellen geht von der Analyse der Problemsituation aus, setzt die Ergebnisse mit den Kenntnissen in Beziehung, um das Verwunderliche, Widersprüchliche zu erkennen und führt zur Formulierung des Problems. Das selbständige Formulieren des Problems ist ein wesentliches Element der Zielorientierung und gleichzeitig ein effektives Mittel der Rückkopplung für den Lehrer.

Das Problemlösen schliesst das Aufstellen von Lösungsideen ein, die verbunden sind mit der Suchraumerweiterung oder -eingrenzung aber auch das Inbeziehungsetzen mit dem Wissen und Können des Bearbeiters. Diese Lösungsideen können Hypothesen, Prognosen oder Prototypen der Konstruktion sein. Sie sind als Aussagen auf ihren Wahrheitswert zu überprüfen. Dies geschieht in der Physik vorwiegend mit Hilfe der experimentellen Methode. Aus der Hypothese werden experimentell überprüfbare Folgerungen gezogen. Die Überprüfung erfolgt durch das Planen von Experimentieranordnungen, das Durchführen der Experimente und ihre Auswertung.

Diese Ergebnisse werden dann mit der Folgerung, der Hypothese und der Problemformulierung in Bezug gesetzt. Dabei ist es wichtig, dass die experimentellen Überprüfungen einen hohen Aufforderungsgrad für den Schüler haben. Wird z.B. in einem Experiment gezeigt, dass der Widerstand einer Spule im Gleichstromkreis wesentlich kleiner ist als der Widerstand derselben Spule im Wechselstromkreis, so wird das Problem aufgeworfen, 'Wie kommt es zu unterschiedlichen Widerständen, obwohl in beiden Fällen die gleichhohe Spannung angelegt wurde? Die Hypothese muss sich auf den Wechselstrom und das damit wechselnde - die Spule umfassende - Magnetfeld beziehen.

Die Selbstinduktion - hervorgerufen durch das den Leiter umgebende Magnetfeld - wird als Ursache angenommen.
Wie ist die Hypothese zu überprüfen?

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[1] Lechner, H: Zum Prozess der Problembearbeitung im Unterricht. In: Physik in der Schule, Berlin 19 (1981) 12, s. 509-515.

Als Folgerung wird aufgestellt: Wenn das wechselnde Magnetfeld verantwortlich für die Unterschiede in den beiden Stromkreisen ist, so müsste eine Spule mit doppelter Windungsführung, wenn die Ströme gegeneinander gerichtet sind (bipolar), nur den Gleichstromwiderstand anzeigen.

Das Experiment ist mit einer Spule durchzuführen, die zwei getrennte Windungen gleicher Windungsanzahl enthält (Abb. 4). Durch Hintereinanderschalten der beiden Windungen

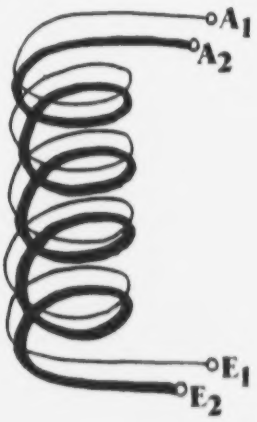


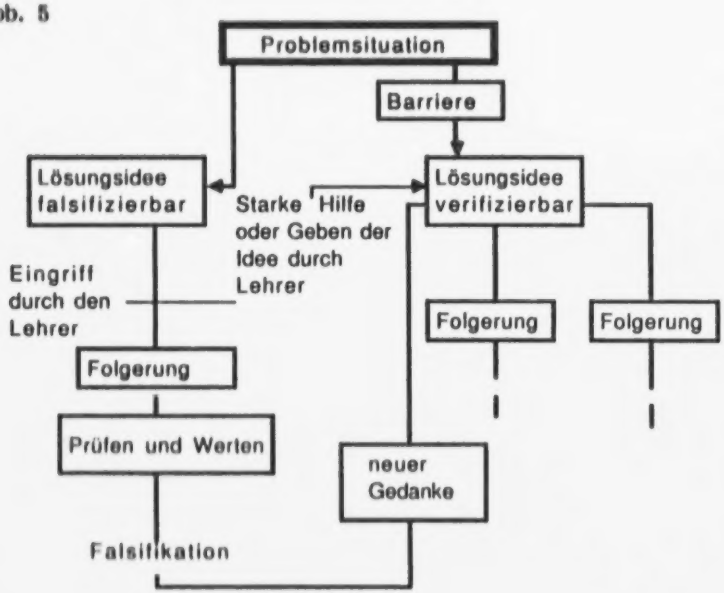
Abb. 4

a) mit gleichem Windungssinn (A_1-E_1-A_2-E_2) und
b) mit entgegengesetztem Windungssinn (A_1-E_1-E_2-A_2) kann diese Erscheinung sehr gut demonstriert werden.

Verzweigte Planung beim Problembearbeiten

Ein wichtiges Merkmal problemhaften Unterrichts besteht in der Einbeziehung der Ideen der Schüler zur Erfüllung des Bildungsprozesses bei Beachtung der altertypischen Besonderheiten.[1] Dies setzt die fachliche und methodische Souveränität des Lehrers voraus. Das wird dem Lehrer - und damit dem Leiter des Bildungs- und Erziehungsprozesses - umso besser gelingen, je genauer er den Prozess vorgeplant hat. Dies ist auch deshalb notwendig, da die durchzuführenden experimentellen Überprüfungen immer an eine gerätetechnische Ausrüstung gebunden sind. Solche müssen im Unterricht zur Verfügung stehen. Eine verzweigte Planung ist ein Mittel, um für einen solchen Unterricht gerüstet zu sein.

Abb. 5



[1] Jäckel, D.; H. Lechner: Selbständiges Problemlösen eine Form der aktiven Auseinandersetzung mit den Lehrinhalten. In: Pädagogik, Berlin 37 (1982) 4. s. 289-299.

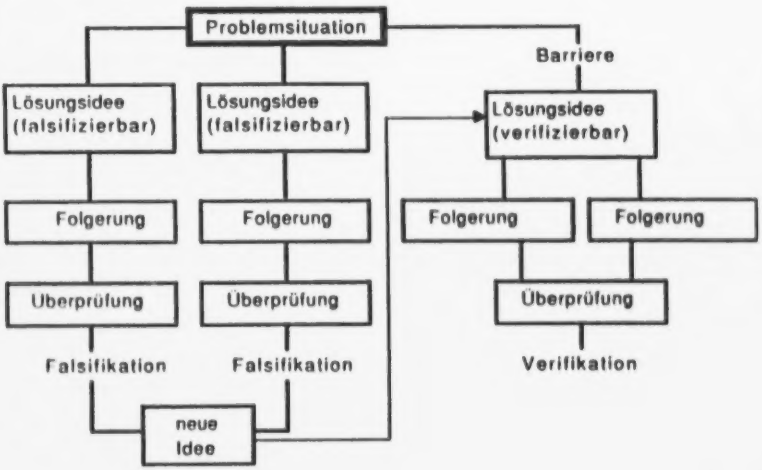
Abb. 5 zeigt das allgemeine Schema für ein Erklärungsproblem. Es berücksichtigt, dass der Weg zur Lösung auf verschiedenen Wegen verlaufen kann und dass für die einzelnen Etappen unterschiedliche Realisierungsmöglichkeiten unter der Beachtung der Schülerideen auftreten können. Entscheidend in diesem Prozess ist, dass für die Schüler entsprechend ihrem Entwicklungstand 'Barrieren' auftreten, die den Zugang zur Hypothese erschweren.

Im illustrativ-erläuternden Unterricht werden durch den Lehrer 'massive Brücken über die Barrieren' geschlagen, das bedeutet vielfach, das Besondere, das Wesentliche wird nicht als solches erkannt. Aber viel bedeutsamer ist, dass den Schülern geistige Arbeit abgenommen wird. Die Schüler nehmen zwar die Inhalte auf, sie werden aber in der Regel nur im operationalen Gedächtnis abgespeichert. Eine Übertragung ins Langzeitgedächtnis wird nur selten auf diese Weise erreicht.

Problemhafter Unterricht geht deshalb einen anderen Weg. Drei typische Wege für die Behandlung im Unterricht seien aufgezeigt.

a) Der Auftrag wird nicht als Problem, sondern als Aufgabe widergespiegelt (Abb. 6).

Abb. 6



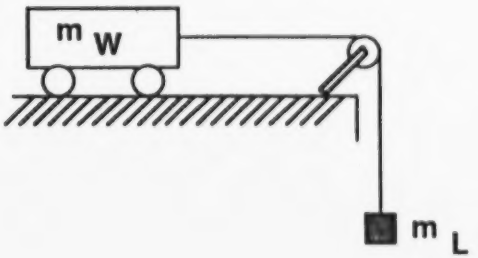
42

Hier greift der Lehrer nicht sofort bei Erkennen der unvollständigen Analyse der Situation oder bei Nichtbeachtung der wirkenden Bedingungen usw. ein, sondern der Schüler führt seine Überlegungen aus und kommt zu einem Ergebnis.

Er wird dann in der Regel vom Lehrer aufgefordert, sein Ergebnis zu überprüfen. Dies führt ihn in diesem Falle in eine Problemsituation, da das Ergebnis der Überprüfung nicht mit dem theoretisch erarbeiteten übereinstimmt.

So sollen z.B. die Schüler angeben, wie das Verhältnis von Masse des Wagens m_W und beschleunigender Masse m_L sein muss (Abb. 7), wenn der Wagen mit einer Beschleunigung von 3 m s^{-2} bewegt werden soll.

Abb. 7



In der Regel wird vom Schüler der Ansatz gemacht

$$m_W \cdot a = m_L \quad g$$

Die experimentelle Überprüfung zeigt eine merkliche Abweichung vom errechneten Weg.

Hier wird also der Schüler nicht sofort darauf aufmerksam gemacht, dass das System beschleunigt wird, wenn eine Kraft wirkt (Grundaussage des Newtonschen Gesetzes), sondern in der Auseinandersetzung mit den erhaltenen Messwerten wird das Newtonsche Gesetz in seiner ganzen Breite erfasst. Das Ziel der Behandlung besteht darin, dass die Schüler die folgende Beziehung finden

$$(m_W + m_L) \cdot a = m_L \quad g.$$

43

b) Von den Schülern werden mehrere Hypothesen angegeben, darunter die verifizierbare. Wie steuert der Lehrer in diesem Fall den Unterrichtsprozess? Zeitökonomisch bietet sich an, die verifizierbare Hypothese zuerst aufzugreifen und die notwendige weitere Bearbeitung (Folgerung, exp. Überprüfung usw.) durchzuführen. Die anderen Hypothesen werden so als falsifizierbar erkannt oder zumindest als nicht zutreffend.

Dies ist ein effektives Vorgehen in einer Spezialklasse mathematisch-physikalisch-technischer Richtung oder in Leistungskursen. Hier können die Schüler aufgrund ihrer Voraussetzungen das Neue, das Wesentliche auch erfassen, wenn sie selbst nicht gleich alle Bedingungen beachtet haben.

Anders ist dies in 'Normalklassen', d.h. der überwiegende Teil der Schüler hat kein besonderes Interesse und keine besonderen Bejahungen für die Physik. Die Fähigkeiten, physikalisch Fragestellungen oder Probleme zu bearbeiten, sind nicht besonders - auch bedingt durch die relativ geringe Stundenzahl - entwickelt. In diesem Fall werden in der Regel nur wenige - in Naturwissenschaft leistungsstarke - Schüler die verifizierbare Hypothese finden, während der grössere Teil der Schüler - auch unter dem Einfluss der 'Alltagsmeinung' - die Hypothesen angeben, die zu falsifizieren sind. Diese Schüler haben aber durch mehr oder weniger angestrengte geistige Arbeit - auch durch Analogiebetrachtungen - diese Lösungsidee gefunden. Werden diese Hypothesen ignoriert, so fällt es den Schülern sehr schwer, das Wesen der verifizierbaren Hypothese zu erkennen bzw. sie suchen nach den Gründen, warum 'ihre' Hypothese nicht zutreffend ist. Das hindert sie aber, aufmerksam den weiteren Gang des Unterrichts zu verfolgen. Sie erfassen somit auch das Wesen der anzueignenden Erkenntnis nicht. Es hat sich deshalb als zweckmässig erwiesen, erst die falsifizierbaren Hypothesen (dies weiss in der Regel ja nur der Lehrer) zu überprüfen. Dies fördert Methodenbewusstheit, trägt zur Entwicklung von Können bei und hat auch weltanschauliche Bedeutung. Da die Schüler daran gewöhnt werden, dass alle oder die wichtigsten Hypothesen überprüft werden, stellen sie sich auf jede Überprüfung gleichermassen ein. Durch die Überprüfung wird Wesentliches von Unwesentlichem getrennt. Dies führt zu einem tieferen Verständnis des Sachverhaltes. Gleichzeitig wird

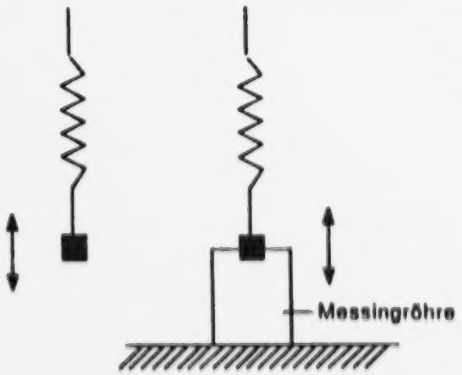
die Mehrzahl der Schüler der Klasse für die Behandlung der verifizierbaren Hypothese aufgeschlossen gemacht. Dies führt zu einem wesentlich höheren Bildungseffekt, zu dauerhafterem, aber auch anwendungsbereiterem Wissen und Können.

c) Von den Schülern werden verschiedenen Hypothesen aufgestellt, es fehlt aber die verifizierbare. Die Barriere auf dem Weg zu dieser Hypothese ist zu gross. Soll in diesen Fällen der Lehrer solange fragen und Hilfen geben, bis diese Hypothese auch noch aufgestellt wird oder soll er selbst diese Idee einbringen?

Bei einem solchen Vorgehen würde das Bemühen der Schüler weitgehend ignoriert. Sie erkennen bald, dass der Lehrer auch noch die 'richtige Lösung' eingibt. Dies würde die Aktivität der Schüler wesentlich hemmen. Es hat sich deshalb folgendes Vorgehen bewährt: Im Unterrichtsprozess wird zuerst nur mit den aufgestellten (in diesem Fall falsifizierbaren) Hypothesen gearbeitet. Sie werden auf ihren Wahrheitswert überprüft. Dabei kommt es zu der schon beschriebenen Trennung von Wesentlichem. Dies führt in der Regel zu einem bisher nicht geäusserten Gedanken, der ein 'Sprungbrett' zur verifizierbaren Hypothese sein kann. (Abb. 5)

So führt die Demonstration eines Federschwingers (mit Magnet als schwingender Masse) einmal offen und das andere Mal in einer Messingröhre mit dem Resultat einer weniger oder stärker gedämpften Schwingung zu einer Problemsituation, in dem nach den Ursachen gesucht wird (Abb. 8).

Abb. 8



45

Dieses Experiment wird in der Stoffeinheit 'Mechanische Schwingungen' vorgeführt. Das Suchfeld für die Hypothese wird deshalb vorwiegend in der Mechanik vermutet. Die Luftdämpfung wird als Hypothese angegeben. Folgerungen mit experimentellen Überprüfungsmöglichkeiten führen dann dazu, dass die Schüler erkennen, dass diese Hypothese in dem gegebenen Fall nicht die ausschlaggebende oder die zutreffende ist. Daraufhin wird eine eingehende Analyse der Experimentieranordnung vorgenommen. Dabei wird auch praktisch untersucht, ob der Magnet als schwingende Masse oder das Material der Röhre wesentlich ist. Im Ergebnis finden die Schüler als wesentlich Magnet und elektrisch leitendes Material. Dies führt zu einem neuen Gedanken: Elektromagnetische Induktion.

In Abb. 9 ist der gesamte Planungsprozess dieser Bearbeitung dargestellt.

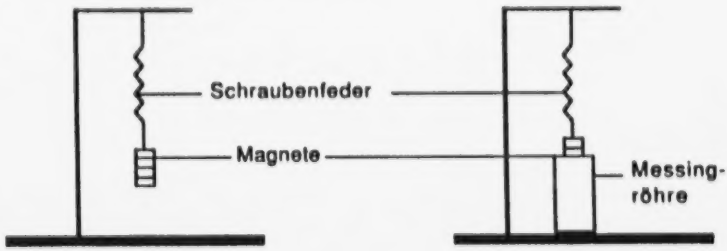
Abb. 9a

Verzweigte Unterrichtsgestaltung

Problemsituation:

Lehrerdemonstrationsexperiment (Parallelversuch)

Eine Schraubenfeder mit Permanentmagneten schwingt frei (a) und in einer Messingröhre (b) /1/.



Beobachtung:

Die Schwingung im Fall b ist stark gedämpft im Vergleich zu Fall a.

Problemformulierung:

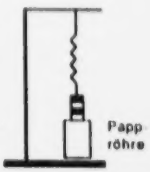
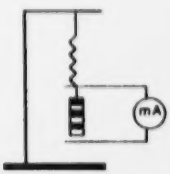
Warum kommt es im Fall b zu einer gedämpften Schwingung, obwohl die Schwinger gleich sind?

46

Abb. 9b

Problemsituation s.o.

Problemformulierung s.o.

Hypothese 1	**Hypothese 2**	**Hypothese 3**	
Luft wird in Röhre zusammengedrückt, kann nicht entweichen und dämpft dadurch Schwingung.	Luftreibung in Röhre bewirkt Dämpfung, da Luft ständig zwischen Magnet und Röhre vorbei muss.	Bewegung der Magneten erzeugt Induktionsspannung in der Messingspule, die der Bewegung entgegenwirkt.	
Folgerung:	**Folgerung:**	**Folgerung:**	**Folgerung:**
Wenn die Luft entweichen kann, tritt keine Dämpfung auf.	(Indirect) Bei Austausch des Schwingers oder der Röhre bei gleichen Abmessungen darf keine Veränderung im experimentierprozess auftreten.	Der Induktionsstrom muss bei Verwendung einer Spule als Röhre nachweisbar sein.	Wenn die Messingröhre nicht geschlossen ist, kann sich kein Induktionsstrom ausbilden. Es kommt zu keiner Wechselwirkung.
Überprüfung:			
			
Messingröhre wird auf Holzklötze gestellt. Luft kann nach unten entweichen.	Bei Verwendung einer Pappröhre tritt keine Dämpfung auf – Widerspruch.	Verwendet man als "Röhre" Drahtwicklungen, kann man Induktionsstrom nachweisen.	Bei geschlitzter Messingröhre tritt keine Induktion auf, also auch keine Dämpfung.
Hypothese wird nicht erhärtet.	Hypothese wird nicht erhärtet.	Hypothese wird erhärtet.	Hypothese wird erhärtet.

Problemlösung:

In der Messingröhre wird ein Induktionsstrom erzeugt, der nach dem Lenzschen Gesetz seiner Ursache entgegenwirkt. Die Bewegung wird gehemmt, die Schwingung wird stärker gedämpft.

Heuristische Führungsmassnahmen[1]

Problemhafte Unterrichtsgestaltung ist darauf gerichtet, dass die Schüler individuell oder kooperativ selbständig physikalische Probleme (im Sinne von subjektiv neu) bearbeiten, d.h. Lerngegenstände durch schöpferische Tätigkeit aneignen. In den vom Lehrer ausgelösten schöpferischen Situationen müssen die Schüler ihr Wissen selbständig verändern und erweitern. Dabei treten beim Übergang zur nächsten Erkenntnisstufe sehr häufig 'erkenntnispsychologische Barrieren' auf, die dem Verlassen der bisherigen Denkrichtung bzw. -ebene entgegenwirken. Im Unterricht sind solche Indikatoren entweder Schweigen oder Bedenken verschiedenster Art, z.B. 'Das geht doch nicht!' 'Woher sollen wir das wissen?'

Wie kann der Lehrer helfen, diese 'Barrieren' zu überwinden? Analysen von Ergebnissen der Methodentheorie, Wissenschaftsgeschichte und Psychologie zeigen, dass entscheidende Ideen für Entdeckungen und Erfindungen durch Übertragen von Bekanntem aus anderen Objektbereichen und Betrachtungsebenen gefunden werden. Auch im Unterricht zeigt es sich, dass Schüler erfolgreich zu Lösungsideen gelangen, indem sie auf Bekanntes, auf Analogien zurückgreifen und dieses Wissen übertragen und neu strukturieren.

Aus dieser Erkenntnis lässt sich das methodische Vorgehen ableiten, welches zur Befähigung der Schüler zum selbständigen Problemstellen und Problemlösen führt.

a) Im Unterrichtsprozess sind Problembearbeitungen langfristig zu planen, damit die Voraussetzungen oder analoge Erscheinungen mit der notwendigen Tiefe behandelt werden. Im Prozess des Problembearbeitens erweist sich so das Reaktivieren von theoretischem und methodologischem Wissen und Können durch Anwendung, Systematisierung oder Wiederholung als heuristische Führungsmassnahme, die dem Schüler hilft, das Suchfeld einzuengen und den zutreffenden Gedanken, die Idee zu finden.

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[1] Jäckel, D., H. Lechner, A. Müller: Führungsmassnahmen im Prozess der Problembearbeitung und ihre Wirksamkeit. In: Berichte der Humboldt-Universität Berlin 1982, Heft 12.

b) Bei der Arbeit in schöpferischen Situationen unternimmt der Schüler Lösungsversuche. Oft führen diese aber nicht zu einem positiven Ergebnis, weil z.B. nicht das zutreffende Erkenntnisfeld gefunden wird. Hier setzt der Lehrer situative heuristische Führungsmassnahmen ein. Dabei ist wichtig, dass diese Massnahmen noch vor dem Erlöschen des Lösungsinteresses eingesetzt werden, um so den Schüler mehr oder weniger determinierend auf eine Suchraumveränderung zu orientieren.

Derartige situative heuristische Führungsmassnahmen können in unterschiedlicher Weise die schöpferische Leistung der Schüler verringern. So reichen diese Massnahmen vom Geben verschiedener Lösungsideen in Form von Auswahlantworten

bis zur heuristischen Anleitung und
zum heuristischen Impuls.

Damit ist ein System von situativ heuristischen Führungsmassnahmen vorhanden, welches zur Befähigung der Schüler zum selbständigen Problemstellen und -lösen beiträgt.

An einem Beispiel sollen situative heuristische Führungsmassnahmen bezogen auf ein Erklärungsproblem dargestellt werden.

> Warum verändert sich bei der Glühlampe die Stromstärke nicht proportional zur Spannung, wie das bei den bisher untersuchten Widerständen der Fall war?

Die angezielte Hypothese lautet: Der Widerstand einer Glühlampe is nicht konstant. Er verändert sich mit der Temperatur des Drahtes.

3 mögliche heuristische Führungsmassnahmen sind:

a) **Zusatzauftrag:** Berechne den Widerstand der Glühlampe für verschiedene Spannungen!
b) **Hinweis** auf die höhere Temperatur der Lampe im Betriebszustand.
c) **Reaktivieren** der Kenntnisse über Energieumwandlungen im Leiter an Hand der Modellvorstellung über den elektrischen Leitungsvorgang in Metallen.

49

Diese drei Führungsmassnahmen verringern in der Reihenfolge a nach c die schöpferische Tätigkeit der Schüler.

In den experimentellen Untersuchungen wurden folgende Ergebnisse erzielt (die Führungsmassnahmen wurden nacheinander der ganzen Klasse gegeben).

Qualität der Hypothesen	Anteil der Hypothesen vor erster	nach erster heuristischen	nach zweiter Führungsmassnahme	nach dritter
keine	53 %	24 %	10 %	8 %
nicht adäquat	25 %	33 %	40 %	37 %
teilw. adäquat	13 %	28 %	23 %	23 %
adaquät	9 %	15 %	27 %	32 %

Das System der heuristischen Führungsmassnahmen umfasst:

Heuristischer Impuls als Denkanstoss zum Reaktivieren und Übertragen methodologischen Wissens in Form von Aufforderungen und Hinweisen, um theoretisches bzw. empirisches Wissen aufzuspüren und zu nutzen.

Heuristische Anleitung als eine geordnete Menge von Aufforderungen zur Unterstützung methodologischen Wissens, mit der die Handlung nur so weit bestimmt ist, dass das angestrebte Ziel mit Wahrscheinlichkeit erreicht wird.

Pauschale Voraussage als ein relativ gering determinierender, allgemeiner Hinweis auf den Suchraum, in dem der entscheidende Gedanke bzw. eine Analogie zu suchen ist.

Zusatzauftrag als eine Aufforderung, bei deren Erfüllung analoge Erfahrungen als 'Nebenprodukt' der Tätigkeit des Schülers zwecks heuristischer Nutzung bzw. Wirkung mobilisiert werden.

Anbieten analoger Sachverhalte

Geben des notwendigen Wissens

Geben verschiedener Lösungsideen in Form von Auswahlantworten

Der systematische Einsatz des Ensembles der heuristischen Führungsmassnahmen und die Möglichkeiten des mehr oder weniger selbständigen Problemstellens und Problemlösens führt am Ende der Klasse 10 zu einem recht hohen Leistungsstand der Schüler. So haben wir in einem Langzeitexperiment Schüler von der Klasse 5 bis Klasse 10 in den Fächern Biologie, Chemie und Physik problemhaft unterrichtet (Gruppe A), eine zweite Gruppe nur im Fach Physik Klasse 6 bis Klasse 10 (Gruppe B), eine dritte Gruppe nur im Fach Physik (aber nur Klasse 9 bis Klasse 10) (Gruppe C), eine vierte Gruppe nicht systematisch problemhaft unterrichtet (Gruppe D). Die angeführten Stichproben erlaubten Aussagen zur Langzeitwirkung der Befähigung zu schöpferischen Leistungen im obligatorischen Unterricht und über die Wirkung von Verallgemeinerungen methodologischen Wissens und Könnens durch gleichartige Behandlung in den naturwissenschaftlichen Fächern.

So müsste die Befähigung in der Gruppe A am weitesten vorangeschritten sein.

In einem Abschlusstest haben wir den Schülern drei Probleme aus den Gebieten Physik, Chemie und Biologie zur Auswahl vorgelegt. Eins dieser Probleme war zu bearbeiten. Folgende Ergebnisse wurden bei der Aufstellung der Lösungsidee erreicht:

Gruppe	Qualität der Lösungsideen keine/ nicht adäquat	teilweise adäquat	adäquat
A	19 %	28 %	54 %
B	38 %	26 %	36 %
C	42 %	34 %	24 %
D	45 %	42 %	13 %

Die Ergebnisse belegen

a) dass eine Befähigung erreicht werden kann,
b) dass es sich dabei um Langzeitprozesse handelt, die nicht in wenigen Wochen und Monaten zu grundlegenden Veränderungen in der Denk- und Arbeitsweise des Schülers führen, und
c) ein koordiniertes Vorgehen in den naturwissenschaftlichen Fächern notwendig und effektiv ist.

Problemhafte Unterrichtsgestaltung im Fach Physik - eine Möglichkeit zur Erhöhung des physikalischen Wissens und Könnens der Schüler[1]

Die Ergebnisse unserer Untersuchungen beweisen, dass schöpferisches Lernen durch problemhafte Unterrichtsgestaltungen wesentlich zu einem höheren Effekt im obligatorischen Unterricht beiträgt. Dies betrifft die Lerneinstellung ebenso wie die Dauerhaftigkeit und Anwendbarkeit des Wissens, aber auch das variable Denken. Dabei berücksichtigen wir, dass intensives Lernen auch mit geistiger Anstrengung verbunden ist. So konnten wir nachweisen, dass problemhaft angeeignetes Wissen anwendungsbereiter und dauerhafter ist. So bewältigen die problemhaft unterrichteten Schüler (Gruppe A + B) in der Regel etwa zu 20 % besser die Anforderungen gegenüber Schülern, die sich diese Inhalte nicht problemhaft angeeignet hatten. Daraus ergibt sich, dass Problembearbeitungen an Knotenpunkten des Lehrgangs durchgeführt werden sollten. In unseren Experimenten hat es sich als günstig erwiesen, etwa 20-25 % der Zeit des Lehrgangs für Problembearbeitungen vorzusehen.

Das bedeutet aber nicht, dass in den anderen Stunden Elemente problemhafter Unterrichtsgestaltung fehlen. So erweist sich die Gestaltung einer komplexen Problemsituation am Beginn einer Stoffeinheit als besonders motivierend, wenn sie genutzt wird, um die Ziele für die Stoffeinheit zu erarbeiten. Darüber hinaus ist es entscheidend, wie es in den anderen Stunden gelingt, die Aktivität der Schüler anzuregen und die Variabilität des Denkens zu schulen. Im obligatorischen Unterricht sind schöpferische Leistungen bei allen Schülern nur bedingt zu erreichen. Zu beachten ist, dass das Interesse und die Begabungen sehr unterschiedlich sind und die 45 Minuten einer Unterrichtsstunde die notwendige Zeit zum Finden von Ideen, von Lösungswegen etc. sehr einschränken. Die Inkubationzeit ist kaum zu realisieren. Eine Möglichkeit besteht in der stärkeren Nutzung der Hausarbeitzeit. Die Problemsituation wird dabei am Ende einer Unterrichtsstunde ausgelöst. Die Schüler haben dann über einen längeren Zeitraum hinweg die Möglichkeit, nach Lösungsideen zu suchen.

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[1] Engmann, D.; Jakoby, K.; H. Lechner. In: Problemhafte Unterrichtsgestaltung in den Fächern Biologie - Chemie - Physik. Heft 12, 1982.

Eine weitere didaktische Massnahme zur Erhöhung der schöpferischen Leistungen besteht im Auslösen kooperativer Lernformen, in der Gestaltung des Gruppenlernens. Es zeigt sich, dass diese Form der Unterrichtsgestaltung eine hohe Effektivität bringen kann, wenn die Schüler systematisch zu einer solchen Arbeit befähigt werden und wenn diese Lernform zur Bewältigung von Teilzielen eingesetzt wird, d.h. es ist der Wechsel von Gruppenarbeit und Klassenunterricht in der Stunde zu sichern.

Damit werden die Grenzen deutlich, die der problemhaften Unterrichtsgestaltung mit dem Ziel der Entwicklung von Schöpfertum im obligatorischen Unterricht gesetzt sind. Für unser Bildungssystem in der DDR hat deshalb der fakultative Unterricht eine besondere Rolle zu übernehmen. Er vereinigt die interessierten Schüler in kleinen Gruppen (bis 14 Schüler). Da das Ziel dieses Unterrichts schwerpunktmässig in der Vertiefung des angeeigneten Wissens und Könnens und erst in zweiter Linie in der Erweiterung liegt, sind besonders gute Voraussetzungen für schöpferische Lernprozesse gegeben, die voll zu nutzen sind.

53

UNIVERSITIES AFTER 1945. THE AGE OF GLOBAL POWER OR CRISIS /1/

Andrzej Radziewicz-Winnicki

The discussion which has been going on in the world for many years concerning university studies syllabi and the shape of contemporary university points to the necessity of working out a new plan of educating and influencing university students. The experience of all the major scientific centres, both in the East and in the West, should undoubtedly be taken into account in order to provide the basis and the starting point for further exchange of opinions. All syllabi and programmes taking a definite stand, even if presented only in general outline, as to the direction of studies, play an important role in the realization of the process of preparing graduates to perform further professional work, to fulfill specific social roles, or simply to shape the natural, rational scientific outlook existing round an individual all his life. Every time they express a specific moment in the reflection of past experience, they are using the results of evaluations and conclusions about the effects of didactic work as well as ideas about future needs.

I neglect here the historical origin of the contemporary university. However, I will quote one of the many encyclopaedic definitions: "University /Latin: universitatis - universality, the whole/: the basic type of a multidepartmental institution of higher learning, the aims of which cover carrying out scientific research, training and educating students, training research workers, and conferring degrees. It is the oldest type of institution of higher learning. As we know, the first universities were founded in the 12th c./e.g. Bologna, Paris/ and in the course of the following nine centuries they underwent a considerable evolution, the most prominent features of which are the democratization and dissemination of studies, the continually growing number of departments and university specialties, as well as the gradual separation of higher professional schools from the classical university, e.g. medical academies, higher technical schools /polytechnics/, agricultural academies, higher schools of fine arts, higher economic schools and others" /2/.

In order to limit the scope of my reflections, the evaluations and opinions expressed here will refer to general or specialistic training in the University studies syllabi. I disregard in this way other important problems which will surely become the subject of interest for many groups of experts. These are, among others, the problems of making use of intellectual abilities in university studies vs. psychological individual differences, the process of socializing of university students, the technology of training at a contemporary university, personal and intellectual conditionings of students' success in learning, the problems of students' self-government and many others.

Although the subjects of my interest are the activities of universities after World War II, it is known that the basic stimulus to all changes and modifications were the economic, social and cultural changes of the 19th century in Europe and America caused by technological progress and revolutionary movements. New social needs arose then, and they required new institutions to meet them. Industrialization and urbanization favoured the development of capitalism and proletarianization of human masses as well as the disintegration of traditional social groups (family, neighbourhood). Tutelar tendencies of philanthropists, local self-governments and governments were parallel to the growth of mass revolutionary movements (struggles for independence, working class and peasant movements). These movements aroused wishes for social justice, civic equality, democratization of public bodies and social institutions, reconstruction of the world, and they led to a growing need for inurement of social activity on one's own, favouring independent working class and peasant organizations. Further, the quick development of technology quickened world changeability, in particular the changeability of professional work and the growth of competence requirements. This required an ability to adapt constantly to the new demands of life and work and develop innate abilities. The necessity of professional perfection and requalification aroused the need of knowledge, first among the more ambitious craftmen, workmen, and peasants. In the course of time this first awakening created a mass wish for "lifelong education", the idea of English trade unions causing the dissemination of school education and the foundation of different institutions of out-of-

school and adult education /libraries, social houses, public universities, etc./. Finally, the gradual limitation of working hours aroused the wish for valuable recreation, good rest after a more and more intensive work with relaxing games, thus fulfilling the needs of self-development.

Above were mentioned four phenomena of the 19th century civilization of the developed societies: 1) socializing and making citizens out of the underprivileged classes aiming at gaining political rights, 2) the growth of the needs of the widest masses in terms of education and culture, 3) care and social help and 4) recreation. Together, they resulted in the unusual development of public bodies, associations, and institutions aimed at meeting the phenomena. Superficially, these were four different categories of needs, but it has been noticed in Europe that, as a matter of fact, they became concentrated as in a lens, on the problem of the conditions in which wide human masses lived, conditions which can disorganize and destroy but, if changed, can develop and enrich. /3/

These facts have completely changed the profile of existing universities. Egalitarianism in education results in propagation of the idea of learning among wide masses of people. The new forms of educating people within the framework of extra-mural studies, public universities, or community schools then become widely known.

The idea of extra-mural studies was begun at the initiative of professors at Cambridge University /1873/, "extending" beyond university walls popularization of their scientific disciplines by means of systematized cycles of lectures. At the same time, the idea behind the popularization was not to weak-en the scientific authenticity of the lectures, not to simplify, not to devoid the presented knowledge of its problems. The listeners were white-collar workers, members of the lower middle class, country teachers, activists in trade unions and the co-operative movement emancipated women, as well as gradually increasing numbers of vocationally trained and working class youth. /It is important to remember that in 1879 the act disseminating elementary school in the British Isles was introduced/. The idea of the University of Cambridge was soon taken over by other British universities, and it met with the support of liberal professional circles everywhere.

The turning point for the idea of university extension was 1908 when the new system of intensive teaching was introduced: instead of lectures in rooms which held a great number of listeners, tutorial classes were organized with from 8 to 24 participants who, under the guidance of a tutor during weekly meetings, (24 two hour meetings a year) would study a given subject, e.g. political economy or native language. Numerous reports on the works of extended universitities state the generally exclusive character of these universities, this manifesting itself in that considerable fees, covered privately or subsidized by the institutions supporting the student, selected as those to gather in tutorial classes persons seen to be motivated to take up serious efforts of self-education.

It is thought that extended universities generally had good management and staff capable of competently using the method of individual work in tutorial classes, while effectively introducing students to the skills of discussion and putting thoughts in writing. The inculcation in these abilities was favored by the small group of students in a tutorial class. The long-lasting vivacity of extended universities is, it seems, caused by the pragmatism of their organizers who were able to create an effectively acting institution of adult education, which will train people who work professionally. The effectiveness of the universities consisted equally in their well thought-out methods of work and in the plasticity of programming the classes, this being constantly up-to-dated due to the needs of the learners and their sponsoring organizations.

What is doubtful about the idea of extended university is its "patron's shape". It was an institution governed by British universities and founded <u>for</u> a certain category of persons. Also <u>for</u> these persons their unions and associations provided subsidiaries enabling them to study. The listener was <u>the subject</u> of exertions of educational organization and educational methods. In this system it is difficult to notice the student as a co-ordinator and a jointly responsible factor of the institution of extended universities.

The public university is a separate model of the educational institution for adults, different from the model of the extended university. It was a product of continental Europe (France, Austro-Hungary and Polish society) and its beginnings were shaped in the last decade of the 19th century.

The first Austrian attempts are connected with Sunday lectures organized since 1887 by the Wiener Volksbildungsverein, a social institution founded to disseminate education. The success of the organization was an encouragement to provide a stronger basis for the educational undertakings among adults (by such means as evening classes) and this led to the establishment of the Volkstümliche Universitätskurse in Vienna.

And the last, the folk university, is an institution of adult education founded in Denmark by the movement of peasant romanticism. It expanded in the Scandinavian countries and from there to Central Europe. It was a boarding institution of higher learning situated in the country or in a small town (in order not to be separated from country environment), meant for a small number of learners (50 to 100 persons), of one kind, gathering for from 3 to 7 months (when there is not much work to be done in the field) and served either male or female youth (the syllabi were different depending on the role of men and women in the country). The syllabi did not cover professional training (agriculture, animal husbandry). To gain these abilities, the graduate was advised to attend an agricultural school. The folk universities syllabi were based on the chosen fields in the humanities, science about man, society, art, they referred to the culture of life, cultural and economical progress /e.g. country co-operative/. The "subjects" were to arouse thought and feelings. /4/.

Thus, the traditional model of a university has been shaped as a multidepartmental institution realizing complex tasks for human progress. In the last 40 years the university has been looked at in a slightly different way. The majority of specialists in the sociology of knowledge or culture have recognized science to be an integral element of culture. Carrying out scientific research, as if producing science, has been qualified as a non-productive activity and work of a given society. It was supposed to be a kind of cognitive activity which is at present specialized in the social process of work /5/.

In the life and activities of social classes (or groups of people) the science propagated by the university occurs gradually, mainly indirectly, resembling the type of material „production and in the forms of the components of productive forces and production relations. The following factors can be

treated as ways and forms of the manner in which science is manifested in the material practice of social classes:

- theoretical knowledge of the nature of natural and social reality and of the laws governing it;
- ways of behaviour towards nature, people, products of man's work based on scientific knowledge;
- objects being the result of scientific (and quasi-scientific) investigations by means of which one can influence nature, people, and the products of their work. /6/.

This dual manner in which science is manifested is characteristic for a society on a high level of productive forces and it is additionally deepened by the following features:

1. The scientific production in such a society after the Second World War is no longer a domain of the institutions of the super-structure which are specialized in this direction. It is expressed in the taking up and solving of problems typical of science by non-academic institutions, e.g. the army or specialized scientific institutions directly connected with the sphere of material production.
2. Practical applications of science and the provision of scientific investigations with a definite content are more and more frequently connected with the specialized activities of material production rather than restricted to the producers of scientific thought themselves.
3. Any progress in science is most closely connected (feedback) with the material progress of productive efforts in such a society.
4. The shape and scope of production of scientific thought is connected with the requirements and needs of material production. /7/.

The contemporary scientific-technical revolution after 1945 is a totally new stage in the process of changing science into a direct productive force. This process not only takes place on an uncomparably larger scale but, first of all, it shows many new features, hitherto unknown, which are manifested in the sphere of relationships of science and material production.

The realization of the achievements of science in production has begun earlier as a result of the occurrence of machine production. However, in the period preceding the epoch of contemporary scientific-technical revolution this realization takes

place together with a specific separation of science and production: a) functional ("model") separation, when the science itself does not take part in the realization of knowledge produced by it, b) temporal separation (long periods of time between the creation of new knowledge and the embodiment in the pro-duction factors) and c) institutional-organizational separation (organizational separateness of industry and science). In the epoch of the scientific-technical revolution there is direct participation of science in the realization of knowledge created by it. The sphere of science is a place of preparing innovations, where research, developmental and inculcating works make up one functional unit with production changing into a pre-production link of the system "science-production", when the production process itself becomes the sphere of the application of science and science absorbs production as its material basis. The merging of the so far separately occurring scientific progress and technical progress into one scientific-technical progress took place. The system "science-production" becomes the ally of science and production and expresses the new stage in the development of science as a direct productive force.

The integration process of scientific activities with production activities has also brought a new scale of scientific research, new institutional structures of science. /8/. The traditional propagator of science undergoes constant modifications. If one were to define the procedures and activities of all universities or other institutions of higher learning all over the world with one word, the most suitable one would be the notion of "pluralism". In pluralism there are, however, certain general issues, being the subject of common interest. It is the result of specialization of studies which is to be found in the majority of the institutions of higher learning in the world and which is both tremendous and dangerous at the same time. The disappearance of general education for the one which is specialized is the result of the fact discussed in the introduction: the increasing independence of the science. It is also the result of low supply of jobs in conditions characterized simultaneously by increasing work effectiveness and unemployment. Thus, we are confronted by many attempts to build new didactic syllabi in the institutions of higher learning. This task constantly recurs in the new changing environment of

those youth who attend universities and it requires constant control by members of the academic staff who search for the forms and methods needed to achieve satisfactory results. In periods during which ideas are exchanged and work is done on the projects of new syllabi it has become evident that the crucial problem of defining the character of the syllabus is to answer the question: who is the contemporary university graduate to be? It is a fundamental issue of mutual relation between general and (socialistic) specialist training in the process of education.

And again, this problem cannot be given a univocal answer. One should look differently at educating a lawyer, a sociologist, or a teacher, and still differently at a student of medicine. Politico-social reality also determines the problem. In the underdeveloped countries one can observe a trend that obtaining higher levels of general education increases the probability of an individual's conformist behaviour. We can say, then that education is an important tool of social change. In the highly developed countries, however, by means of training, by means of higher education, an individual enters the so-called group controlling the existing status quo. Thus, it does not play such a clear role as an instrument of changes. I am only mentioning this problem, without considering it further, although it seems to be quite interesting.

In any case, blundering towards a constant and rather narrow specialization after 1945, the Universities seemed to have been asking themselves a basic question: General education or specialization? The problem is not to contrast two types of studies - general with the features of negatively understood "academism" and specialist-practical which is narrowly practical. This alternative is ruled out by a practical experience which is the demand for graduates in local job markets.

The problem appears to be important and disputable at the same time when we separate the perspective of connecting theoretical preparation with the requirements of social practice, and general education with specialization. From this point of view, the problem of working out a programme which would take the requirements of theoretico-methodological preparation into consideration, should not be separated from the widely understood relationships between the social, political, or material reality surrounding a given university.

Without going into details of particular problems one can distinguish (see: J. Wojnar-Sujecka, 1976) the following four important issues:

1. The general relationships between general, theoretico-methodological and specialistic education;
2. The basic rules of constructing the syllabi;
3. The stage of general studies;
4. The stage of specialistic studies. /9/

For general considerations on the relationships between general and specialistic education an introduction of some additional elements defining the conditions of these connections and interdependencies might be necessary. The starting point for the analyses and conclusions may be the following observations.

As it follows from the former practice, university graduates (in the majority of cases) do not take up a job in accordance with their specialist preparation. Both the possibility of obtaining employment and the motivation to look for it are varied. In many cases they are the result of accidental factors (e.g. an offer, family situations) and not the planned system of making use of qualified staff. The question thus arises of whether such a situation should be considered in programming the plans of studies and, if so, to what extent? Or should it be taken into consideration at all? The basic rules of constructing the syllabi are connected with the planned time of studies. Assuming the limited time of intramural studies and the unquestioned need for combining the rules of general and specialistic training, the necessity to divide studies into two stages arises: the first with the prevalence of theoretical subjects and problems and the second, with the prevalence of specialistic subjects and problems. The differences known today in the world are considerable. The M.A. in psychology, sociology, history, etc. can be obtained after from 3 to 5 years of full-time study. It depends solely on the syllabus, country or university which imposes a definite course of education.

Another aspect of the division of intramural studies into two stages is the problem of counteracting the too far reaching disintegration of the specialists' horizons in particular fields, thus weakening the possibility of educating the open-minded graduates. The general tendencies of contemporary didactics which should be taken into account in the syllabi are, in

theory, characterized by the postulate of falling off from the too well delineated directions of specialistic training, thus reducing their too excessive number. Another problem is the global division of specialistic fields in the future perspective. The future development of each of them must be considered, but this must also be related to the growing demand for the qualified staff with specialistic training.

A separate place should be devoted to individual studies. The possibility of taking up individual course of studies opened many years ago has more and more advocates, and this also includes students. In the totality of the process of university education this type of realizing an individual syllabus may make a quantitatively small but very important factor in the full activation of individual aptitudes and acquisition of deepened knowledge and abilities. Full appreciation of the advantages of individual syllabi, already today one can sense the apparent difficulties in the course of taking and completing them.

The first refers to the choice of a field of specialization within the course of individual studies. This choice cannot be treated as an insufficiently well thought out escape from the unsatisfactory suggestions of the general syllabus binding in a given department, in terms of the number of realized specializations. The choice of the field of individual studies may, first of all, take into account the scarce branches which require educating a few but essential specialists. The coincidence of the individual "interests" of the student applying for the right to realize an individual course of studies, with the actual needs may be the criterion for making the decision. However, lack of formulated needs of this type has resulted in the fact that, in practice, the decisive moment up until now has been the individual suggestion of a student supported by the permission of the possible tutor. From the formal point of view, the decision is, of course, taken by the academic authorities.

Another aspect of the problem of individual studies is the possibility of realizing syllabus similar in its scope not by one student but by a small group. It can have certain advantages, both didactic and essential. The problem arises, however, if, in this shape, it will not become an informal way of creating specialist training not anticipated by the syllabus.

Particular difficulty appears in the period of formulating the suggestions of individual syllabi. As a matter of a fact the period devoted to this work is very short.

Another difficulty is the possibility of the occurence of a certain divergence between the formal evaluation of the course of studies and the effects obtained in the realization of very ambitious individual plans. They occur when the individual syllabus anticipates a serious increase in the number of subjects and the introduction of additional examinations of a complementary character from a different field of knowledge, which would require a considerable expenditure of time and be characterized by great difficulty. Their punctual execution (and sometimes even obtaining the optimal results) is particularly difficult, which was not always observed when the syllabus was being prepared. In such a situation the individual programme which was ambitiously planned and really prepared for the independent solution of new problems does not, in the evaluation of formal realization, qualify those students who are most capable and work hardest to obtain the prizes.

In the general aspect the type of the individual course of specialist studies which most often trains future research workers constitutes a great risk for each institute or chair, since it requires particularly close attention and frequent evaluation. /10/.

Thus in the light of the past analyses it is difficult to recognize univocally the University sciences after 1945 as either one great success or a definite failure. Certainly it was the period during which the myth was ended of the grandeur of a great humanistic University and its hermetically closed circle of wise research workers and talented students. In the social opinion, it was the end of the university's position as a leading force of science. Technical sciences in particular started to develop intensively in non-academic centres. The creators of the programme which led to man's landing on the Moon had very little in common with the University, that is to say, their current job at that time.

But it is also true that contemporary egalitarianism in education is the result of the universities' activities in the world. The fight of evolution and progress with old structures starts, after all, at Universities' courts, though not much research has been conducted on the influence of 1968, the so-

called students' revolution, on structural changes which have taken place in many countries in the world.

Still everybody is interested in the University, its shape and activities. When we speak about the perspectives of anticipated changes we constantly return to the traditional vision of the University.

One can distinguish at least two trends in the reflexion devoted to the value of university science for the entire society, for all the men of the world. One backs up the hope that, thanks to the climate of discussion, understanding, and activity characteristic of this mecca of knowledge, the problems of different threats facing the contemporary world will receive a practical solution, the threats being: illness, hunger, natural disasters, war, social inequalities, injustice in mutual relations between people, and the individual's alienation from the society and culture. The second trend critically analyses the applications of research workers in practice, especially its connection with technology and with being a certain group of people in authority over others. This trend has its representatives among those critics of industrial society who call for changes in the structure and functioning of the present institutions, either in the interest of the old romantic university ideals of the return to the natural state which would make it possible to enjoy life, nature and direct contacts of people, or in the interest of ideals of a society which would be rationally abundant in goods and realize the postulates of justice and order.

The literature devoted to the problems of the role of universities in the periods of scientific-technical revolution characterizing the political and social relationships in which the interests concerning science in which the aroused interests concerning science could be fulfilled, disposes of this criticism and tries to define the conditions in which the promises of making technology more scientific and making economic use of science could be fulfilled. /11/.

The great Polish scientist F. Znaniecki introduced the sociological concepts of the role of "man of knowledge" and social circle which needs this knowledge into the reflexion on the university science and its connections with society. After many attempts to apply the notions used in analyses of the work of the purposefully created administrative, commercial or

industrial organisms, in the analysis of the organization of scientific work, F. Znaniecki's concepts find advocates trying to describe and explain, what within science entangled with social life is really going on. /12/.

And these issues are of central topical interest now. They are useful when general reflexion on social institutions or on the position of science as value in the system of values leads to their being recognized and characterized by ideologists, this resulting in our being able to pass to a description of what university scientists are doing, both as research workers and as social activists (educators), as teachers. /13/.

Surely all of them look for understanding and a competent receiver of the results of their research and analyses. Despite frequent misunderstandings (e.g. the difficult dialogue between the producers and users of social science research) both parties have objective interests in common. Both of them undergo many educational influences making them understand the indispensability of scientific knowledge for social life and the necessity of developing science in academic centres, employing the appropriate candidates in them, organizing the conditions for competition, and allowing for the results to pass on to all those who may find them useful in connection with man's participation in economic, educational, and cultural activities. All for the growth of citizens' welfare, their happiness, and the multiplication of cultural goods covering, among others, also scientific cognition.

Moving on to the final conclusion, I do not think I will be able to answer univocally the question posed in the title.

We are entering the twenty-first century and the role of university science as a method of cognitive conduct and the collection of models and the tools for solving the particularly important problems for the development of a given society increases in the contemporary organization of social life. This historic process is simultaneously the realization of the old Enlightment (18th c.) postulates which speak about the importance of a scientific method of conduct.

In those societies which are developing outside of the sphere of European intellectual culture, more important has become the slogan of shaping "the scientific temper", in other words, a scientific attitude rather than an opinion on the world based on scientific knowledge. The notion of scientific

knowledge and scientific method imply the existence of univocal patterns of thinking and cognitive conduct which may be passed on to different types of activities. Thus, the scope of higher education will still grow in response to the new requirements of students or local groups, to new needs connected with scientific research, to the demands posed by the local communities as well as to appeals to make the universities contibute to the quickening of social reforms or solving the existing weak points (such as unemployment) in the form of prevention and compensation. /14/. New structural types of universities, new students and the changing syllabi will be followed by the fundamental changes as far as the methods of evaluating the results of studies are concerned. The students' participation in the management of universities and the process of education will still develop as well as extramural, evening and postgraduate studies.

It does not mean, however, that we shall observe divergent and even contradictory undertakings in other fields than anticipated. It may concern the limiting of the development of education, e.g. centralistic activities, state control, central systematization in some countries, pluralism, decentralization, decreasing state control in others.

In any case the university of the twenty-first century will, like once in the past, take over the deep sense of educating in contemporary world, this being its responsibility towards the present generation which it is to prepare for a world of hope and futurity, with its possibilities and myths, perspectives and final aims being based on these concepts.

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REFORM INTENTIONS AND THEIR IMPLEMENTATION [1]

Erik Wallin

Introduction

This paper is a discussion of aspects of the relation between a school reform and its implementation. In other words it is a discussion of aspects of the arena of formulation of a reform and the arena of implementation. This issue is discussed against a Swedish background of mandated reform. My interest will be the compulsory comprehensive school and mostly its curriculum. It has also to be said that the curriculum that is developed and decided upon by parliament and government is due to be followed all over the country. So far the Swedish system is a very centralized one, but there is at this very moment a strong tendency towards decentralization. The curriculum is intended to give the base for a standard of schooling that is the same all over the country, but the aims and syllabi are phrased in such a way that it shall be possible to make adaptations to the local conditions and also give room for teachers and pupils to influence on what actually is being done in the schools.

As in other countries education for the labourmarket's needs has been important for the reform intentions since 1950. The main background factors, however, are found on another level. The development and the reforms would not be understandable if we did not see educational development and the development of the educational system in a perspective of equality and social policy. Educational policy and so on and so forth. So the reforms of the educational system are part of a whole national programme of social policy. The point of departure of the development of the educational system has not been the school itself but school and schooling as part of society. This has been on one hand very favourable. On the other hand it has of course created difficulties in realizing the intentions of the reform. Education as part of social policy brings new aims and new aspects into education, aspects that are foreign to traditional conceptions of what schools and schooling are good for and therefore difficulties are created.

[1] This paper was based on an invited address given at the AERA Annual Meeting, San Francisco, April 1986.

This brings me straight into my theme: into political ambitions and their realization. Into reform and its implementation. Into educational aims and educational or pedagogical traditions.

Educational reform as part of the political arena sets the stage for curriculum theory research. It also highlights the research perspective we have chosen and which I would define as follows: the state is the mandator of the school system. This means that the decisions are taken on a state level, by parliament and government, in order to be implemented by an existing educational system. The decisions are also to be accepted and being considered as legitimate not only by the educational community but also by society at large.

If we confine ourselves to the educational community we can say that in a research perspective the meeting point between mandator intentions and the educational community in terms of pedagogical traditions and often implicit values are crucial for our understanding - and for curriculum theory.

The concept of mandator acknowledges that schools are there for some reasons and that there are intentions and aims that should be realized. Another way of expressing this would then be to see the relation between political ambitions and their implementation as an issue of steering. I will return to that.

The concept of reform

As reform is a major concept of my theme I should give some attention to that. It is possible to distinguish two aspects of social reform: "preserving the system" and "transcending boundaries". In another context (Tangerud & Wallin, 1986) and probably more familiar to us as educationalists I have discussed the same distinction as to what concerns the school in terms of change.

On one hand there is change taking place within existing goals and organizational framework without change of basic aims and values. This means the adoption of new techniques and methods to increase efficiency and effectiveness under present conditions.

On the other hand there is change as change of existing goals and organizational framework. This also means change of basic aims and values and methods of work: of end and means. Examples of this kind of change are the intended school reforms in different countries after World War II aiming at the creating of more democratic school systems.

Lindblad (1980) makes a similar distinction in a discussion on educational reform and educational development work. Lindblad uses the terms "reformist reform" and "dynamically conservative reforms":

> The reformist method is ... a method of social change within the framework of society, making use of reforms and state intervention. However, reforms and state intervention can also be a way of preserving basic social conditions by checking minor ills in a society seen as fundamentally good. Reforms and state intervention can thus also be methods of achieving a dynamic conservatism.
>
> How, then, can we tell whether a reform or an instance of state intervention is reformist or dynamically conservative? This question is presumably crucial to a policy of reform which is not intended merely to administer the status quo. I believe the following criterion can be regarded as both primary and decisive: a reform is reformist if it is reasonable to assume it will result in shifts in power or ownership relations between groups and classes in society in favour of the oppressed.
>
> If there are no ground for making such a claim regarding the implementation of a reform and its effects in practice, it is, by the same token, impossible to claim that the reform is reformist. (ibid., 24).

With Lindblad's distinction in mind it could beyond doubt be said that the Swedish school reform is a reformistic reform. As part of not only social policy but also of a will of a political majority to create a more democratic society its ultimate aim is to achieve a change in power relations in society. So far it is indeed a matter of politics.

The next question is, however, what happens to the reform when it is being implemented, when it is planned for and

brought down into classrooms. The net effect could be a dynamic conservatism as a reaction both on political grounds and on a base of old tradition and institutional rigidity. The reform intentions are disarmed or eliminated and in a sense of more of the same the old system becomes still more what it was. If this happens it could be stated in pedagogical terms as a counter reaction of the system. But it could also be stated in political terms because pedagogical actions are implicitly valuebased and valuebased as far as to allow an interpretation of their meaning in political terms.

An example: Grants for operating costs of the school

I would now like to give an example of what may happen to a reform decision. The example illustrates what can happen on different levels of the political - administrative - and to some extent on the school teacher level. The example might seem somewhat peculiar and restricted in scope but I would argue that its meaning and implications are general.

The organizational reform of the compulsory school was considered settled around 1970. Swedish school policy during the 1970s was, therefore, mainly concerned with the internal work of schools. The report (SOU, 1954:72) of the Commission on the Internal Work of Schools (the SIA Commission) was published in 1974 and, following the usual circulation process, was converted into a Government Bill, which was passed by the Swedish Parliament (Riksdag) in 1976. This policy decision formed the basis for Riksdag resolutions in 1978 concerning a new system of state funding for schools and a revised compulsory school curriculum. The latter was fully implemented in autumn 1982.

On July 1, 1978 a new ordinance was introduced concerning Government grants for the operating costs of Swedish compulsory schools. The aim was to replace a system characterized by strong central control by one which would make it possible to take the decisions nearer to the level of implementation, in order that funds might be distributed according to local needs in a more flexible manner than formerly. The decision on a new Government grant ordinance was one of the first and most concrete results of the work of the SIA Commission.

We (see Berg & Wallin, 1986) were engaged in a follow-up study of the reform. The main objective was to study opportunities for this kind of reform to influence and change educational practice in Swedish schools, and barriers to such influence.

The basic empirical observations are related to how the reforms have developed over time, from committee work, through decisions in parliament to implementation. The analyses focus on the intentions of the reform programme and its contents and effects. The reform of the state funding system differs, however, from earlier Swedish school reforms over the past decades in that a high degree of decentralized decision making is used in implementation. Decentralization was not meant to function as a superordinated principle but as an aim on the same level as certain other aims. There were restrictions as to its scope and position as a principle. Superordinate to the principle there was stressed, e.g. the principle of equal educational standards in all Swedish schools.

Reform implementation in a system of decentralized decision making focuses on the question of steering and control. The traditional exercise of authority by the central school administration (at the state level) was a form of direct steering by detailed rules, control and a variety of administrative and formal decision functions. It has now been changed into a system of steering that more than previously guides and gives advice and encouragement to the local level. Following the SIA decisions the focus of central control was placed on steering and also on development through sharing of experiences and information. The model of steering was thus changed from mainly administrative steering by rules to goal steering based on information.

What happened to the policy programme from the time of the Commission in the early 1970s up to the time of our latest empirical studies in the early 1980s?

In all the preparatory work done relating to the reform, certain concepts recur which seem to be of central importance to the reform of state funding for schools. All of these concepts are policy concepts, in the sense that in some way they express the essential substance of the goals and purposes of the reform. These central concerns are: difficulties, needs, resources, decentralization and evaluation. The SIA Commission

defined the values of these five concepts as primarily socially related difficulties, personal and qualitative resources, social needs, political decentralization, and evaluation as an instrument of rational planning. This is the starting point of the reform policy in terms of aims and values.

The fact that the concepts bearing the values of the policy are more or less clear in meaning represents a problem as regards their function as instruments for steering the implementation of the state school funding reforms. Though the expert members of the Commission formulated their views relatively clearly, we can observe how the concepts became increasingly more abstract during the political decision making process.

By way of illustration I have chosen to describe how the con-cept "needs" has been dealt with.

In the SIA Commission's terms of reference it is stated that changing the internal work of schools can only "be discussed on the basis of pupil's needs". The earlier educational policy goal of giving every child equal access to education was no longer considered sufficient.

The Commission said:

> The goal should be set higher, to relate to quality in terms of the conditions which promote learning. This requirement entails a right for pupils to achieve an equal educational result according to their individual potential, which may necessitate different educational resources for different pupils. (ibid., 239)

So far it is clear: educational results according to individual potential. The pupils should be given the opportunity to develop their full potential. This talks in favour of compensatory measures and for socially determined criteria of needs. This was also the standpoint of the Commission. But these criteria are difficult to define and operationalize. One way is to get indirect indices of socio-economic factors by using test - achievement or intelligence test. It goes without saying that this opens up for a, let me say, statistical definition of need. Needs are defined by standing in the group and not in relation to the pupil himself. There are other problems that I leave out here.

Even the SIA Commission perceived two different types of needs, that can be seen as cognitively or socially determined. In its report, the Commission opts for the social interpretation of the concept. It also points to the technical difficulties involved in measuring needs.

When Parliament later considered the SIA proposals, the concept was not clarified. If anything, on the political scene, the reverse happened. The concept became more and more watered down and ambiguous. The compensatory aspect became more and more diffuse and there was more and more room given for both social and cognitive interpretation. Empirical studies show that many local authorities have increased their use of cognitively oriented tests as a basis for resource allocation among schools. This can be seen, among other things, as a reaction to insecurity from ambiguity.

On local community level and school level it can also be observed that the concept is not absolute in the sense that it has the same meaning for everyone. It cannot be used in a uniform manner in discussions of resource utilization or when choosing methods of work etc. Rather it is relative, i.e. tied to the particular context constitued by a school or by a group of teachers within a school. This also leads to insecurity - and sticking to what is well known and sure.

To be short, there has been a marked shift in the values and goals of the reform programme. This is due not only to the concept of "need", but need is illuminative and central because of its relation to other basic concepts and concerns.

What were the effects?

What effects has the new state funding system had on school organization in terms of both quantitative output, with respect to different school activities and categories of pupils, and qualitative output, in terms of changes in educational practice and the degree of support for values underlying the major conceptions of the reform?

It seems that the new state funding system has had very little effect on school organization and on the value orientations of school staff.

The SIA reform, with its changes of the state funding system, exemplifies the extent to which a central political decision concerning reform in the school system may possibly change educational practice.

It seems that the planned and intended change in allocation and utilization of resources has not come about in practice. The change in steering from administrative rule steering to information-oriented goal steering has not been effective.

The reform rests on the possibility of rational implementation of reforms. It was considered possible, in the complicated school organization with political and administrative system at different levels, to change actual practices at the base level: in classrooms, school units, school management districts etc. by decentralized decision making. This whole process had to be carried out bearing in mind the balance between how far local decision making could be allowed and the general and common goals laid down for all schools. One could talk of a mandator's (the state's) interest and the interests of the executive (the school level).

Behind this conception of the basic premises for steering there are a number of ideas of rationality:

- the system as a whole is characterized by consistency in terms of the conception and interpretation of goals,
- this means that there is consensus concerning main issues,
- contradiction in terms of values can be resolved by some form of social technique,
- political decisions provide enough guidance for for mulating pedagogical goals.

Rational action within a decentralized system of decision making like the one described imposes stiff demands on the politicians and civil servants and teachers who have to realize and implement the reform. In this respect the decision on reform strategy builds on an idea that the actors concerned have professionality or that professionality might be developed.

Another, related idea and premise is that actors at different levels and positions in the system have a sufficiently wide grasp of the goals and tasks of the organization as a whole to make local choices of pedagogical action from this conception

of the whole. The SIA reform is very broad in compass. If in different sectors of the organization there are actors who do not have this total view of the aim of reform, they will instead have a fragmentary picture of the underlying intentions. Behind the model of steering decided upon there is an implicit conviction that this fragmentary picture can be avoided or does not exist.

If these are premises for implementation that have not been existant the problems of reform can also be considered from a perspective of steering in a more narrow sense.

When the central rules on resource allocation were abolished, they were not replaced by uniform and unambigous, centrally decided principles for processing at different levels. There arose scope for alternative norm system and action at the local level, legitimized precisely by the absence of centrally formulated norms. The situation was characterized by unclear central goal formulations, goal conflicts, shortcomings in implementation, and conflicting value conceptions among politicians, administrators, and other policy-making groups. All this can be seen partly as a result of the dilution and fragmentation taking place throughout the political and administrative implementation process.

In such a situation there arises a call for steering - pressure for stability, "order", administrative norms etc. The decision-making process for resource allocation can be compared (this metaphor is developed by Odin & Åhs, 1986) to a low-pressure area. Such an area tends to be filled. Air flows from surrounding high-pressure areas towards the centre of the depression and the pressure gradient is levelled out. It is in such situations that the "low-pressure" hypothesis acquires meaning. One overflow is from the old rule system.

Remnants of the old steering system survive in the form of structural elements in the organization of work. Old rules that in fact have been discarded linger on because they are cornerstones in complex and demanding routines which people have often had a lot of trouble learning to cope with. If they are applied, these remaining rules and routines can make it impossible or difficult to use other routines needed, say, for decentralized decision making. Taking account of this co-existing, lingering rule system pushes reforms in a conservative direction. In fact these rules serve to guarantee that no system changes will come about.

Reform and system pressures

What I thus have described and discussed are some key issues in reform and reform implementation. The case should be seen in the context of a pluralistic welfare state with a considerably centralized system of government. The main issue, however, cannot be understood unless the reform and its implementation are related to the character of the Swedish school system with its emphasis on the state as mandator. Since the state is a balance of societal powers then on the one hand steering signals from the mandator tend to become diffuse and on the other hand the system of steering schools presupposes rationality. What we have found in our studies is that this rationality is not to be presupposed.

By way of summary I would say that the vacuum that arises when the old rule system is removed creates a basis for new types of steering when there is decentralized decision making in a complex school system. Our conclusion is that the "low pressure" hypothesis holds. As it is unclear what is entailed by decentralized decision making as regards school resource allocation, we might well ask whether the reformed system of state funding for the operating of schools is not in fact one which works very well on the system's own terms, i.e. it meets certain elementary requirements for public-sector activities in a pluralist society. It is the basis for the reproduction of the existing educational community and as such the most adequate system for public resource allocation within the school system. In somewhat simplified terms, I would like to draw attention to the following:

- The system formally provides resources for different forms of resource allocation among pupils (the equality aspect).

- The system permits differences on value issues through a level of abstraction which makes different interpretations possible with no real control or steering by the state (the freedom aspect).

- The system increases the potential of the democratic system by formally enabling more people to be involved in decision-making processes (the democracy aspect).

- The system allows different educational practices side by side within an organizationally integrated school for all citizens (the freedom of choice aspect).

- The system conceals the fundamental value conflicts of society, thus creating ritually conditioned calm and balance. If schools appear to be treated rationally, they are also perceived to be rational. At the same time they present a range of different solutions which make possible ritual public debate. People feel at home (the security aspect).

- The system permits technical changes to the allocation processes (the development aspect).

All parties can subscribe to the various aspects: equality, freedom, democracy, freedom of choice, security, and development. Since these concepts are not assigned meaning by being related to a defined social context or a clear basic philosophy of education, it is possible for them to continue to be differing interpretations on the school system of a pluralist society. At the same time the notion of rational steering can be maintained. Decentralized decision making and resource allocation according to needs thus become both a compromise solution and a conflictfilled educational and societal dilemma.

It could also be questioned whether decentralization is cause or effect. Whether decentralization is a cause of pluralism or whether it is an effect in the sense that it is a way of handling pluralism of a society. If the latter is true, decentralization as effect, rational central planning is being so difficult that the problems are moved down. Many scholars today seem to adhere to that idea.

Rationality and ambiguity seem to be crucial terms and concepts at this point. Both are related to pluralism, and especially pluralism in highly developed welfare state with strong interest-groups. Decisions as well as aims have to be compromises and therefore ambiguous. This seems to hold true for all western societies.

For the Scandinavian scene I would like to draw attention to another circumstance of importance. This concerns the degree of comprehensiveness of a country's school system. Turning this around makes it an issue of degree of pluralism of the very system. (Cf Tangerud & Wallin, 1986). The Scandinavian countries seem to form one extreme on the continuum

of organizational pluralism in the school system. This is where the term "comprehensive education" is taken in the strict sense of giving very near to the same education to virtually all pupils over many years. At the other pole we find some nations, often big ones comprising several religions, histories and languages, with a much higher degree of pluralism in the school system.

In a comprehensive system on a rational of equality you usually will find a central core curriculum, as in the Nordic countries, which has status as a legal document to be adhered to by all schools. This document is an expression of political ambitions (or a compromise of several ambitions). In this situation existing pluralism enters the school and creates a scene for fight for power and conflicts within school. This takes place in terms of interpretations of and attitude to the legal document. In a more diversified or liberal system, the main fight for power and the conflicts are more found between different interest groups outside school.

The difference between the two system orientations implies different situations for teachers and parents in terms of values and choice. In a liberal system values are made explicit and become an issue of choice of school. In a comprehensive system parents and pupils make their choice within school usually among formal options the value base of which is more or less clear. The teacher brings his values to the school in terms of the conception he has of the options. This is how conflicts are brought into the schools.

Reform and implementation - pessimism or optimism?

What I have tried to show is on one hand that the content and meaning of political decisions per se are changed as they are taken care of before and during the implementation. The political meaning is changed as an effect of the complexity of a pluralistic society and of the complexity of a political and administrative school organisation.

It would be possible to talk of two arenas: one arena of formulation where indeed policy shifts occur and one arena of realization, where shifts also occur. These arenas differ in terms of strength of interest groups which leads or can lead

to policy shifts. They also differ by definition as to the demand on the arena of realization to transform political aims into pedagogical actions.

The crucial issue is that pedagogical actions have meaning in themselves. Pedagogical actions are not neutral and performed out of a context. They have, in other words, a meaning in terms of values, and of consequences now and in the future. They have a meaning that ultimately might well be phrased in political terms. In this sense, of course as I see it, also tradition of the schools, their rituals and peculiarities have a political meaning. This is due also concerning premises for pedagogical actions, as e.g. the use of the state grant system.

My examples illustrate policy shifts both as to what concerns reform decisions and to their implementation. I have so far, however, not been able to argue for policy shifts - or if you like - effects of the profound stability of the educational system on a classroom level. It is my conviction that the very basic pattern of classroom interaction, of teaching patterns in classrooms is what it has always been. Much research seems to show that (cf. Ahlström et al., 1986).

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